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Concrete Houses
and How They Were Built

Articles on Various Types of Concrete Houses and Problems of their Construction with Plans and Detail Drawings, compiled from CONCRETE in response to a demand greater than could be met with copies of Housebuilding Numbers of that magazine.

Edited by
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GEORGE E. MAYCOCK

Concrete-Cement Age Publishing Co.
Detroit
1917

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Concrete-Cement Age Publishing Co.
Detroit, Mich.

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Engineer Builds Economical Concrete House With Simple Equipment[1]

The house which is the subject of this article is valuable as an illustration of what can be done with concrete by an individual not equipped with commercial forms, who expects to build his own residence only. J. F. Hahn,[2] who has for some years been engaged as designing and constructing engineer on various classes of reinforced concrete work, was in the same position as many others; he realized distinctly the advantages of a concrete house, yet was confronted with the impossibility of securing a favorable contract price as compared with other materials, owing to the unfamiliarity of most builders with this class of construction.

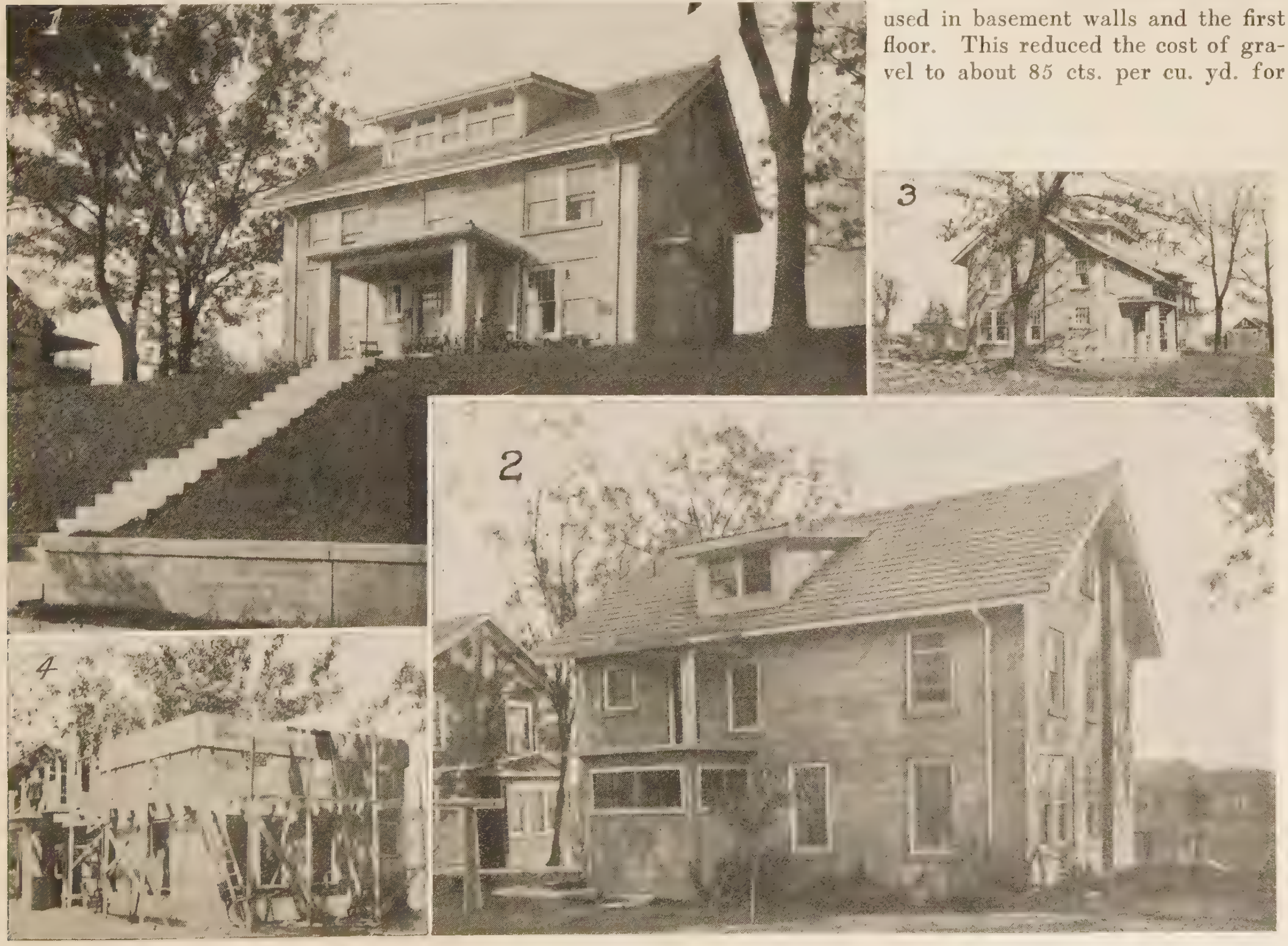
The house is from the owner's plans and was constructed under his supervision. It is as shown by the illustrations, extremely plain in outline, but it is well proportioned and well suited to its surroundings; situated on an elevation among stately old trees, its simple, strong lines stand out in a particularly favorable setting.

The house is 25′ x 36′ in plan, the basement height from floor to floor is 7′ 8″, the first story 9′ 6″, the second story 8′ 6″. There are a front porch, a rear porch and a sleeping porch. The house contains nine rooms and a bath, besides sthe basement and the attic. As will be seen by the plan, the living room and the dining room occupy the entire front. In the living room is a concrete brick-faced fireplace. The entrance is protected by a vestibule. At the rear of the first floor are the library, the sewing room and the kitchen.

The second floor provides four bed rooms and a bath room. Ample closet room is provided, including two linen closets. From the hall access is provided to the sleeping porch at the rear of the house and to the attic, which contains a large amount of storage space and could, if necessary, be divided into three sleeping rooms. The basement is subdivided by concrete partitions which support the main partitions and the first floor. Aside from the usual space for heating plant and fuel storage, there are a good sized laundry and a store room in the basement.

CONCRETE

Concrete was of bank-run gravel with the larger stones removed. A considerable amount of the gravel was found at the excavation and was used in basement walls and the first floor. This reduced the cost of gravel to about 85 cts. per cu. yd. for



Figs. 1-4—Front, Rear and Side Views of Residence of J. F. Hahn

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[1] From Concrete, Jan., 1916, p. 8

[2] Civ. Engr., Jackson, Mich.

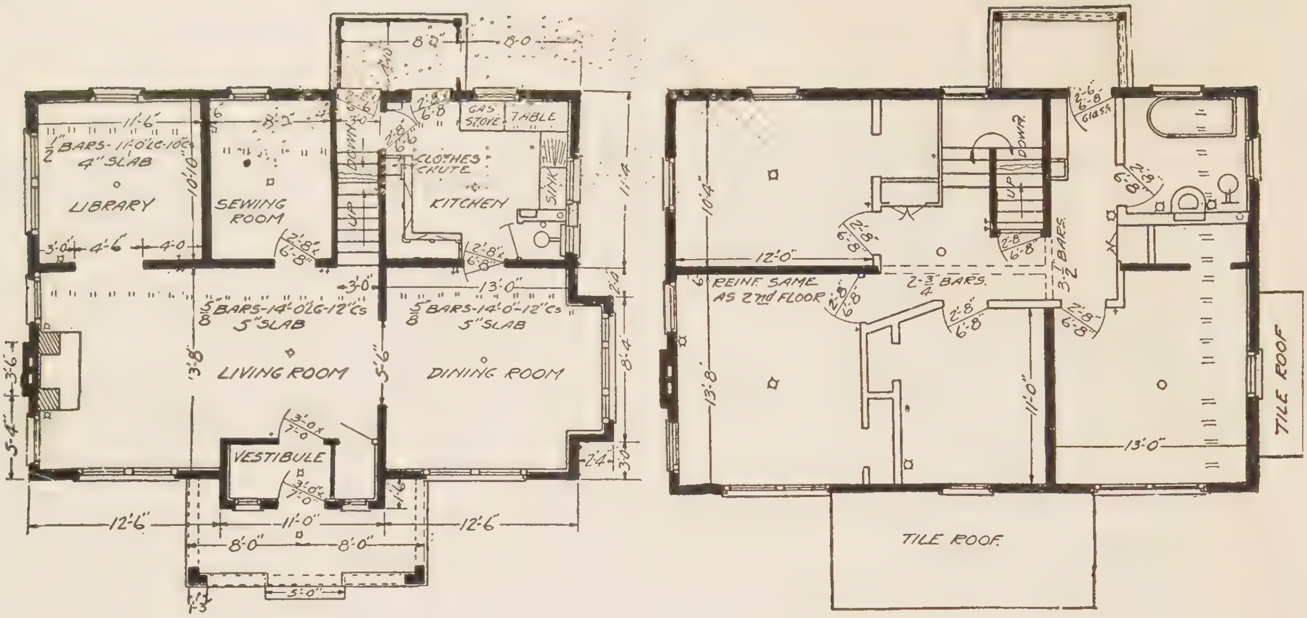

Fig. 5—Floor Plans, Showing Steel Used

the entire building. Cement[3] was used to the amount of about 175 bbls. and cost $1.50 delivered at the job. A continuous mixer was rented for the work.

All concrete above the basement walls was mixed approximately 1:4½, cement and pit-run gravel. The concrete was very dense and practically waterproof.

Reinforcing—The walls were reinforced horizontally with ⅜-in. x ⅜-in. twisted bars 16″ o. c. and the same size bars were placed around openings.

The reinforced concrete floors are supported on concrete bearing walls except for short spaces carried on girders as shown on the plans. The floor slab was reinforced with square twisted bars of size and spacing shown.

Forms—The wall forms for the superstructure were sectional, 2′ 6″ high, made of 3-in. x 10-in. boards nailed to 2-in. x 4-in. pieces at about 2-ft. 6-in. centers. Inside and outside forms were held in place by 5/16-in. bolts and spreaders. The inside of the outside forms was covered with a cheap grade of 2-ply roofiing felt having a rough grained surface. The roofiing felt was used to avoid the smooth, glassy surface characteristic of concrete where smooth wood or steel forms are used. The paper also served as a gasket between the forms and the concrete wall previously built and in nearly all cases the form was watertight and made a joint that is barely noticeable. After the concrete work was finished, the forms were taken apart, the boards were used for roof sheathing and the 2-in. x 4-in. pieces for fillers in second floor partitions. The rafters and the second floor ceiling joists were used for supporting floor forms and for staying. In this way all the lumber that could be charged to forms is the waste from cutting, which did not exceed 500 bd. ft.

Handling Concrete—The concrete was handled by hand and no hoisting equipment or runway was used. As the concrete was poured in sections about 30″ high, the first section was easily handled with buckets from the ground. The second section was poured by a man standing on a portable platform who took the bucket as passed to him from a laborer on the ground. The platform was moved along as the forms were filled. The same procedure was followed by adding an additional man for each rise of the forms, up to the second floor, when the material was hoisted to the second floor by three men at the rear porch and the procedure was repeated. While this may seem a crude way of handling the concrete, when one considers the very small quantity that is required for a 6-in. wall 30″ high, allowing for openings, and that this was an isolated job which would not warrant an investment for staging equipment, it will be found that this was probably as economical a procedure as could have been followed. The light mixer used was easily moved from one side of the house to the other so that the concrete had to be carried a very short distance.

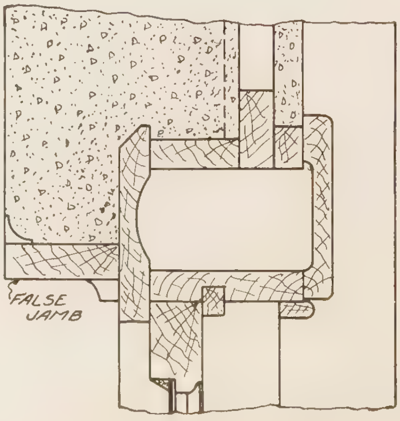

Fig. 6—Window Frame Details

The first story required two days to set up forms and pour the concrete for each section, thus requiring 8 das. to build a story height. The work was done by a superintendent, one carpenter and two laborers for the first two sections, three for the third and four for the fourth. It required 6 hrs. to 7 hrs. to set up the forms and 2 hrs. to 3 hrs. to fill them with concrete. The work was so arranged that all forms were filled at the end of each day. This part included the concrete partitions.

The second story walls without partitions were built in 4 das., or at the rate of a section per da. To pour the concrete an additional laborer was employed for each additional section in height. The additional laborer was used only a few hours each day while pouring concrete, the local labor situation permitting this arrangement.

SURFACE TREATMENT

The forms, covered as previously described with roofiing paper, did not leave the surface in a glassy condition and there was comparatively little streaking from leakage. While the house looked rather spotted at first, two years' exposure to the weather has evened up the color to a remarkable extent and the surface, which is practically as left by the forms, is far from unattractive. It has a sturdy individuality; it is an honest expression of an honest material and will continue to grow more attractive as the years pass.

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[3] Mich. Portland Cement Co., Chelsea, Mich.; Peninsular Portland Cement Co., Jackson, Mich.

ROOFING

The roof frame is of wood and in it were utilized the plank which had been serving throughout the job as staging and supports for floor forms. Practically every scrap of lumber could be used in sheathing the roof, so that there was very little waste. As roofing tile was to be used the roof was prepared by covering with waterproof paper which was held on by lath running up and down the slope of the roof. These laths also act as furring strips for horizontal 1-in. x 2-in. strips to which the tile are secured. The tile were made on a Brock roofing tile machine,[4] which is a simple piece of equipment consisting mainly of an arrangement for molding on pallets which give the proper shape to the bottom of the tile and a troweling member running on guides which trowels and gives the proper form to the top surface. The tile were first made to an approximate shape and then a surface coating of red iron oxide was sieved over them and the troweling finished. This gives a very good color which seems to be fully equal to that of the burnt clay tile, while irregularities in placing the color give variety in the depth of the shade which results in a very pleasing roof. It is interesting to note that the tile were made and placed on the roof at about $12 per square.

CONSTRUCTION DETAILS

Fortunately the mistake was not made in this house of attempting to secure a dry and thoroughly insulated building by means of a single concrete wall and provision was made for furring and lathing. This is done as illustrated in the sketch, by tacking V-shaped strips to the forms at proper intervals, to which vertical furring strips were afterwards nailed. The concrete partitions and first floor ceiling were not lathed, but the plaster was applied direct, with entirely satisfactory results. Considerable thought was expended upon a proper window frame detail which should be simple and entirely weather tight, yet which could be used readily with a 6-in. wall and not interfere with the forms. The result of Mr. Hahn's work is shown in an accompanying detail. Study of the detail will show that the jamb, headpiece and sill could be separated from the rest of the frame and readily replaced. A false jamb was used outside, as shown, to act as a form for the concrete. This was, of course, removed and a staff bead put on after the forms were removed. Each frame was set assembled complete, then the jambs were match marked, numbered and taken off until the concrete work was complete. It will be noticed that this style of frame provides not only an airtight joint and a form for the concrete, but also suitable nailing for the interior trim. The porches are of concrete poured in forms, but the panels in the rear porch are of stucco on ribbed metal lath over sheathing. The floor and roof of the sleeping porch are of poured concrete. The roof is colored with red oxide to match the roof tile; the iron oxide was troweled in as with roofing tile. The concrete sills were cast in place in suitable spaces left for them, it being considered easier to do this than to take care of the complications sills would involve in the form work. The chimney is of concrete, poured with the house and provided with square vitrified tile flue lining. The use of concrete has been extended to all the surroundings of the house, as will be noted by the long flight of concrete steps, the retaining wall, sidewalks and even the concrete lawn roller and T-shaped clothes line post which can be seen by close inspection of Fig. 2.

INTERIOR FITTINGS

The finished floors are of oak and yellow pine, nailed to 2-in. x 2-in. screeds laid directly on the concrete sub-floors, except in the vestibule and the toilet room, where ceramic tile floors are used. All partitions not indicated as being of concrete on the plans are framed of wood in the usual manner. The trim on the first floor is of oak of a plain and tasteful design and the second floor rooms are finished in yellow pine, enameled, and birch mahogany. A vacuum vapor heating plant has been installed, which, together with the concrete construction, has reduced very considerably the fuel required for heating.

The kitchen and the laundry are piped with gas and in the laundry is installed a Diehl automatic water heater which supplies hot water at all times to laundry, kitchen and bath rooms. The house is lighted by electricity and gas. The plumbing consists of toilet on the first floor and bath room on the second floor, with the usual equipment of kitchen plumbing, and an automatic soft water pump in the laundry. A clothes chute communicates between the laundry and each floor.

COST

In estimating the cost, the owner's time as superintendent is included at $4.00 per da., but no contractor's profit is added in the total cost, although it is figured on certain parts of the work which were let out on contract. It may be added, however, that this work was done at an exceptionally favorable time and that the figures obtained from contractors were probably unusually low. The notable feature of this work is that, in spite of the fact that this was an isolated building, erected by workmen who had had little or no previous experience in this class of work, a fact which was, to a certain extent, offset by favorable prices for materials and favorable labor conditions, the cost of the concrete work, which includes the basement and entire structural part of the house, came to slightly more than $1,000. The remainder of the cost went into woodwork, millwork, plastering and accessories which would necessarily be figured at the same cost in any kind of house. It is evident, therefore, that not only this concrete house has not cost more than other types of structures, but in all probability Mr. Hahn has actually effected a saving over any other material. He has a house which will require no upkeep for years to come, which removes to a large degree the fire hazard as evidenced by the lower insurance rates, which is more easily heated in cold weather, yet is cool in the heated season, and which will continually become more in harmony with its surroundings as the years pass.

COST DATA

Excavation contract ....$	40.00	$ 40.00
Cement	266.64	
Gravel and sand...........	116.10	
Steel	79.85	
Mixer (rental)	20.00	
Labor on concrete and forms	578.00	
Total concrete cost.....		1,060.59
Roof tile and sheet metal contract	236.00	
Plastering contract	228.30	
Lumber	528.19	
Mill work	158.49	
Carpenter labor	420.44	
Total lumber and carpenter		1,107.12
Hardware, rough and finished	93.43	
Plumbing contract	308.00	
Heating plant	336.83	
Painting (does not include walls where left white)..	133.45	
Electric light wiring and fixtures	108.40	
Hardware, heating, plumbing, light and painting		980.11
Incidental mason supplies..	56.54	
Miscellaneous labor	28.02	
	$3,736.68	

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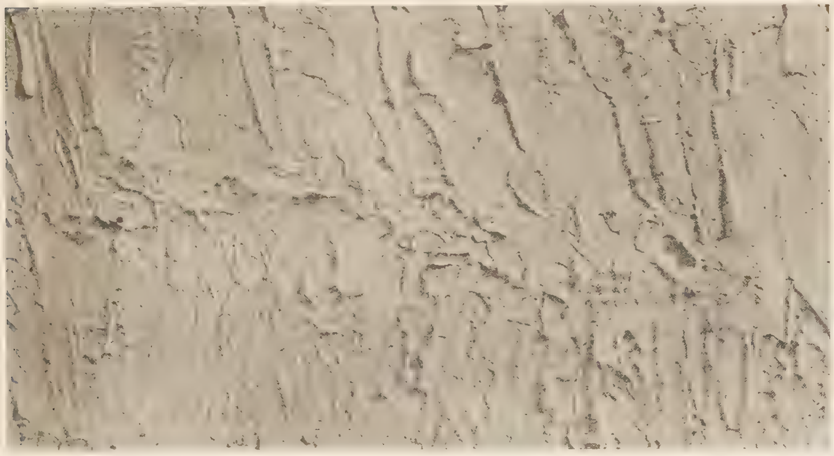
[4] Brock Bros., St. Louis, Mo.



Figs. 1 and 2—G. Gordon Massey Residence of Poured Concrete at Middleburg, Va. Detail of Stucco (Area Shown, 2/3 sq. ft.) at Left

Thin Stucco Finish on Garden Walls and Buildings Near Middleburg, Va.[1]

(Contributed)

In the mind of even the layman who has watched the construction of a house of reinforced concrete, there is no question of concrete's superiority as a structural material, but we must recognize the fact that if the reinforced concrete house is to take the place which it deserves in the building world a radical change must be made in its appearance and exterior treatment.

The demand is for a finished, workmanlike surface as it comes from the forms, and the writer wishes to acknowledge frankly that with the usual methods this has seemed almost unattainable.

We can theorize on the artistic side and argue that the exposed aggregate is the true concrete surface, or we may satisfy ourselves with the reasoning that the form marks should remain and show, being natural to this way of building, or we may go further and use a tooled surface. But while these wall finishes may be excellent for some types of houses, I believe that all builders who have tried these methods of finish know the difficulties encountered and have often themselves been disappointed in their results obtained.

Stucco and rough-cast surfaces seem especially suited to concrete buildings and offer great artistic possibilities, but in many instances in which this material has been applied in the usual way, the stucco has come loose and peeled off, and it is generally considered difficult to apply stucco over concrete so as to produce a good, permanent finish.

It is a common saying in these times that while a man is saying that a thing cannot be done he is quite likely to be interrupted by another man doing it, and this is true in stucco over concrete, and "the man who made it stick" is none other than a Virginia builder operating in a

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[1] From Concrete, Jan., 1915, p. 24

FIGS. 3 AND 4—A GARDEN WALL OF CONCRETE WITH SLAP-DASH STUCCO FINISH AND AT THE RIGHT EGG-SHELL FINISH AND A SECTION OF UNFINISHED WALL. THE STUCCO IS ¼″ THICK (AVERAGE) AND COST 15 CTS. PER SQ. YD. FOR MATERIAL AND LABOR

A feature of this finish and in practically all of the other stucco finishes put on under Mr. Haga's direction is in the fact that workmen are not permitted to "fuss" with their work. It has been very hard to get them to press on the stucco firmly with one free stroke and then *let it alone.* But that is what is done on nearly all of the Haga work. In Fig. 4 the holes where the spacing rods for the steel form sections were driven out have been pointed and the surface is ready for stucco

rural section of Landam Co., 12 mi. back from the railroad.

The work of C. H. Haga is illustrated and described on other pages but up to the time of his death early in 1915 his work constantly increased in scope and, while he started in the construction of small cottages and farm buildings, the Haga-built houses are established as a standard for the entire section and sought for by rich and poor alike, not because they are cheap, but because they were the best that money could buy. The fine exterior finish and consequent attractive appearance are not the least of the reasons for this phenomenal success.

To obtain straight, smooth walls, as well as for economy in erection, Mr. Haga has used on all this work one of the standard makes of pressed steel wall forms,[2] equipment which he has already used over hundreds of times without apparent damage.

On the first buildings he was careful to have the stucco applied while the walls were green, but in the later buildings he has found this precaution unnecessary and often the stucco has not been put on until months after the walls were up. At first the wall was roughened to give bond but this was also found to be unnecessary, and the finish was applied on the smooth surface, just as left by the steel forms. Work of this sort has been done at all seasons of the year except in the dead of winter.

To test the bond the writer has tried to remove the stucco in several places on the various buildings, but invariably the chisel takes a part of the concrete off with the finish, showing a perfect bond. It is hard to account for this except by the fact that the coat is put on only ⅛″ to ¼″ thick and does not act in the same way as a heavy thickness of stucco.

First, the wall is thoroughly drenched about an hour before the work is applied and again immediately before the work is started. White or gray Portland cement is used with clean sand or stone dust. It is applied with a steel trowel but great care is taken not to touch the work after the first stroke. This gives that free, almost careless appearance so characteristic of the best Italian stucco finish, and the walls have a uniform, workmanlike appearance, yet show great variety, as no two spots are alike.

The stucco mix is 1 part cement to 1 part sand or crushed stone, with 10% by volume of hydrated lime added. In warm weather the stucco is sprinkled and kept damp until it has set up quite hard. Coloring matter, when desired, is mixed in the mass but enough is mixed dry for an entire side before the work is started. The work is done by plasterers. The cost of the material with white cement is a trifle less than 6 cts. per sq. yd., and the labor cost is about 9 cts. per sq. yd., so that the total cost of this attractive finish has averaged only 15 cts. per sq. yd.

One of the advantages of the rough surface is that any slight imperfections in the wall or stucco do not show and in one of the buildings an extra rich mix was used in the stucco and it was applied in hot weather.

Much of the work on the various buildings has now stood perfectly for nearly 3 yrs., and shows no defects and seems to be as hard and permanent as the wall itself.

When using wheelbarrows as a unit of measure, they should be brought to a level when filled; a small top on the wheelbarrow load looks like a small matter, but may in fact mean a material decrease in the proportional amount of cement. Wheelbarrows containing the required amount when level full can easily be obtained. Bottomless boxes made to set in the wheelbarrow can also be used to measure the materials correctly.

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[2] Morrill System

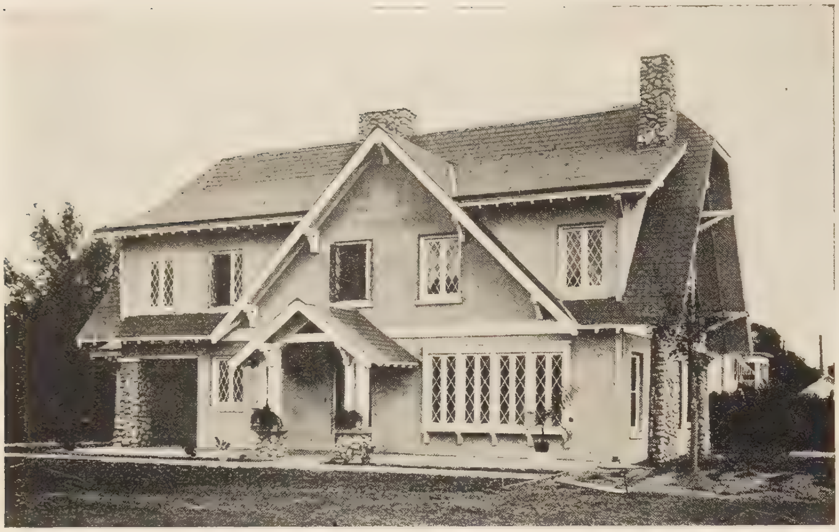
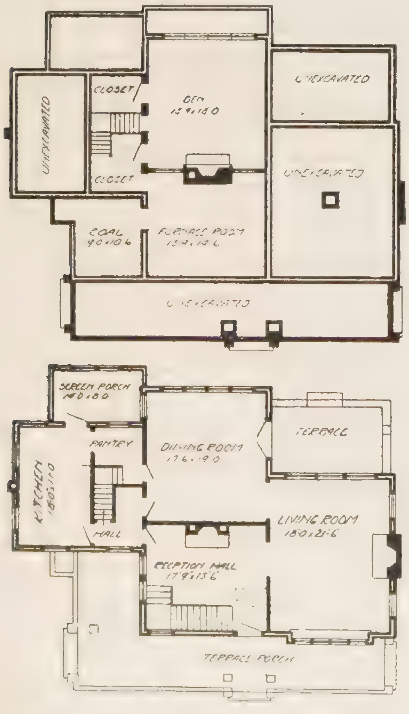


Fig. 1—Residence of L. Williams at Waco, Texas

Concrete, Boulders and Casements, Features of Waco House[1]

The belief that still lingers in the minds of many otherwise well informed persons, that a concrete house must be of stern and forbidding appearance, would be forever dispelled by a visit to the residence of L. Williams at Waco, Tex.

This attractive residence, which was designed by Edward H. Reed[2] and built by Harris & Hewitt,[3] is far from looking severe or cold. Its cost was moderate. The plans show a basement, which contains a large den in addition to the rooms for the heating plant. The first floor provides large living room and dining room, reception hall and kitchen. On the second floor are three bedrooms, a sewing room and a bathroom.



Figs. 2 and 3—Basement and First Floor Plans, Waco House

CONSTRUCTION

The walls are of hollow monolithic concrete construction from basement to roof. They were constructed without forms with a hollow wall machine.[4] This machine consists essentially of a box-like piece of equipment about 5′ long provided with a collapsible core and in use is placed in position on the footing; then the wall chambers are filled with concrete of just such consistency that it will not sag when the machine is released. Having filled the machine, a single movement of the lever releases it from the wall and it is instantly pushed ahead and again filled. This operation is repeated around the wall, when it is generally found that the first course has hardened sufficiently to bear the weight of the light machine and another layer can be immediately placed. Suitable provision is made for reinforcing and for placing window and door frames and for all other construction details. The walls as left by this process are rough, no attempt at finish being made during their construction. They are, however, an ideal surface for the application of plaster and stucco.

The exterior of the house is finished in Portland cement stucco and the interior is plastered direct to the concrete wall, without fear of dampness, owing to the double construction.

The builders have itemized the cost of the house, exclusive of the slate roof and oak floors, which were furnished under separate contracts. These costs are based on the following wage scale: Plasterers, 87½ cts. per hr.; painters, 50 cts. per hr.; laborers, 25 cts. per hr.; carpenters, 50 cts. per hr.

Details of Cost

Excavating	$ 258.40
Concrete walls and footings	1,088.80
Brick and cobble stone	500.00
Plaster, stucco and concrete floors	1,402.00
Tile for bath room	54.00
Iron	38.00
Wiring	167.00
Tin and heating	489.00
Hardware	200.00
Labor on carpenter work	1,465.00
Mill work and labor	1,390.00
Lumber	1,235.00
Painting	700.00
Plumbing	600.00
	$9,588.20

The concrete house has great possibilities because with known methods, the concrete house, large or small, *can* compete in cost with other structural materials, value for value, and while concrete properly erected does not suffer by comparison in appearance and while concrete possesses advantages in permanence, insulation, ability to use local material and in fire protection, which are denied competing materials, still, in spite of this, the *CAN* in this possibility comprehends vastly more knowledge among architects and builders of concrete and how it should be handled. They have wrestled with the problems of big building construction and in large measure solved them. There are big rewards for builders who will so wrestle with the problems of house construction.

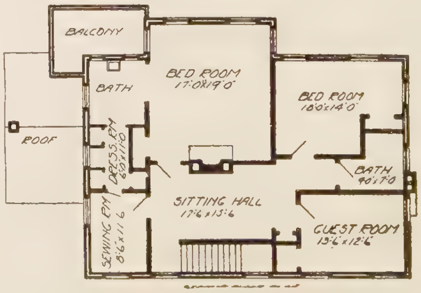


Fig. 4—Second Floor Plan, Waco, Texas, House

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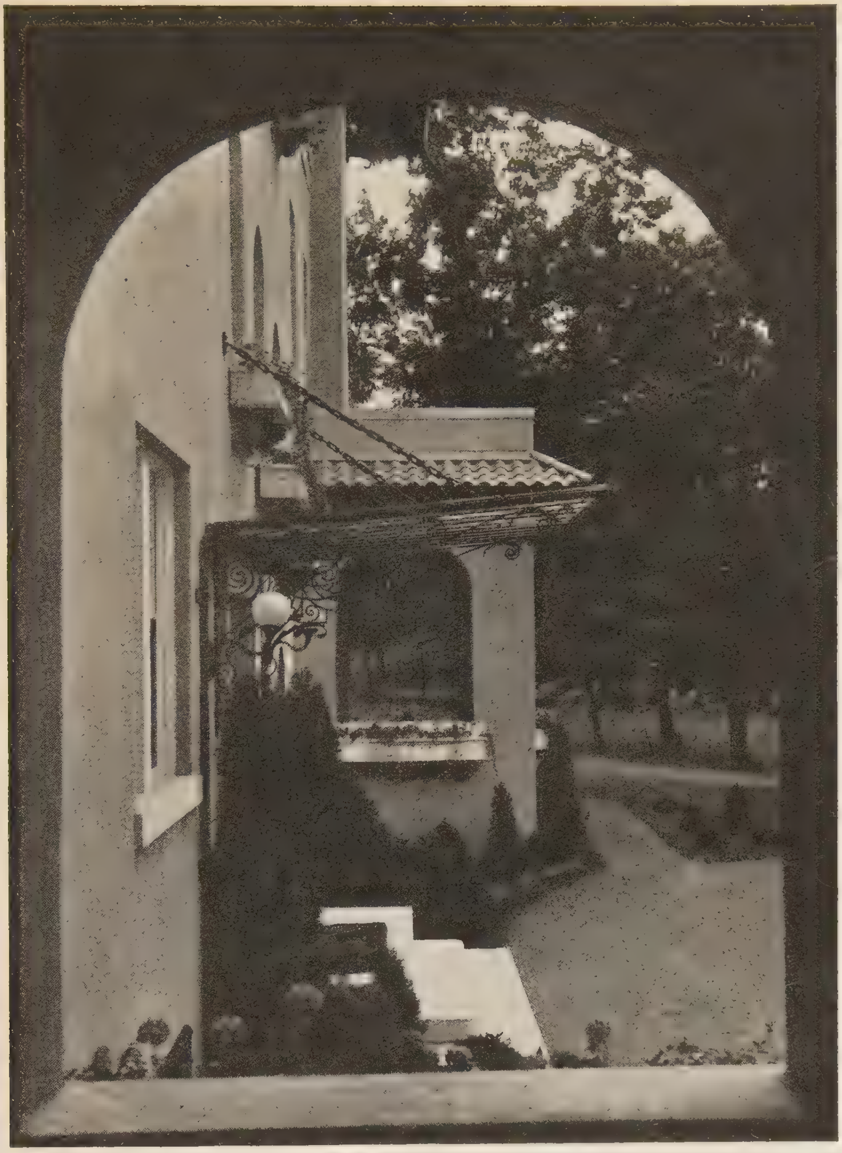
[1] From Concrete, Jan., 1916, p. 28

[2] Archt., Waco, Tex.

[3] Contrs., Waco, Tex.

[4] Van Guilder Hollow Wall Co., Rochester, N. Y.



Detail of Louis K. Hyde Residence

Interesting Residence on Watchung Mt. Has Features of Concrete[1]

Features of the residence of Louis K. Hyde at Plainfield, N. J., as designed by Franklin B. Ware and Arthur Ware, architects, N. Y. C., involve the use of concrete in several very interesting ways. The house was built on top of Watchung Mountain and in preparing the site and the excavation there was excavated a large amount of rock which was crushed and used in the concrete. The hauling problems, otherwise, would have made the cost of building materials excessive, because of a haul of several miles up the mountain side.

The accompanying illustrations give an idea, not only of an interesting plan, but of very attractive details in many respects. The construction is fireproof, all the foundation walls being of concrete, the upper walls of tile and the floors of reinforced concrete. The finish outside is of stucco of a most pleasing texture. The floors are of heavy construction, using heavy Clinton wire[2] and rod reinforcing and, as no cinders could be had without an unusual haul, the stone which was excavated on the site was used in place of cinders.

In the garage, in the stables in connection with the residence and in the entire attic, which is given over to the use of children for a playroom, there is a smooth granolithic finish.

The stucco was put on in three coats, the finishing coat being a mixture of white Atlas cement[3] and white Lakewood sand, dashed on.

A great deal of concrete trim was used for the brackets under the roof rafters and for brackets supporting flower boxes and for all window sills, cornices, porches, porticos, copings for service yard, etc. Concrete trim was also used for the mantels, one in the entrance hall and one in Mr. Hyde's den and a cast concrete fountain in the breakfast room. Models and molds for all of the exterior cast concrete trim were made in N. Y. C.[4] and shipped to the site, where the actual casting and curing was done. Tooling and also other finishing work was done after the work was in place. Casting the exterior trim at the site saves a great deal, in view of the peculiar hauling problems. The molds for the work being comparatively light, were cheaply shipped, and many of them were used repeatedly. The interior concrete trim, including the mantels[5] and the fountain,[6] were made in N. Y. C. These are in reproduction of antique stone, the fountain being of a lighter finish, intended to blend nicely with the sutcco surface of the walls.

The finish of the attic is really a feature of the house. It is well lighted from two ends and it was decided to utilize the entire area for the children. Because of this it was desirable to make it as nearly indestructible as possible. The floors are granolithic and the walls and ceilings also have a smoothly finished Portland cement surface. All corners and angles are rounded and there seems to be absolutely nothing in the entire room either to chip or to wear out. These concrete surfaces were finally painted with a light tone gray-green cement paint in order to give more light.

The house is very complete throughout. Besides the two plans shown there is a very complete basement and a full third floor, besides the attic.

In connection with the grounds there is a tennis court constructed of reinforced concrete on a solid stone foundation. This stone foundation, however, is natural to the site. The court was constructed very much as

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[1] From Concrete, Jan., 1916, p. 10

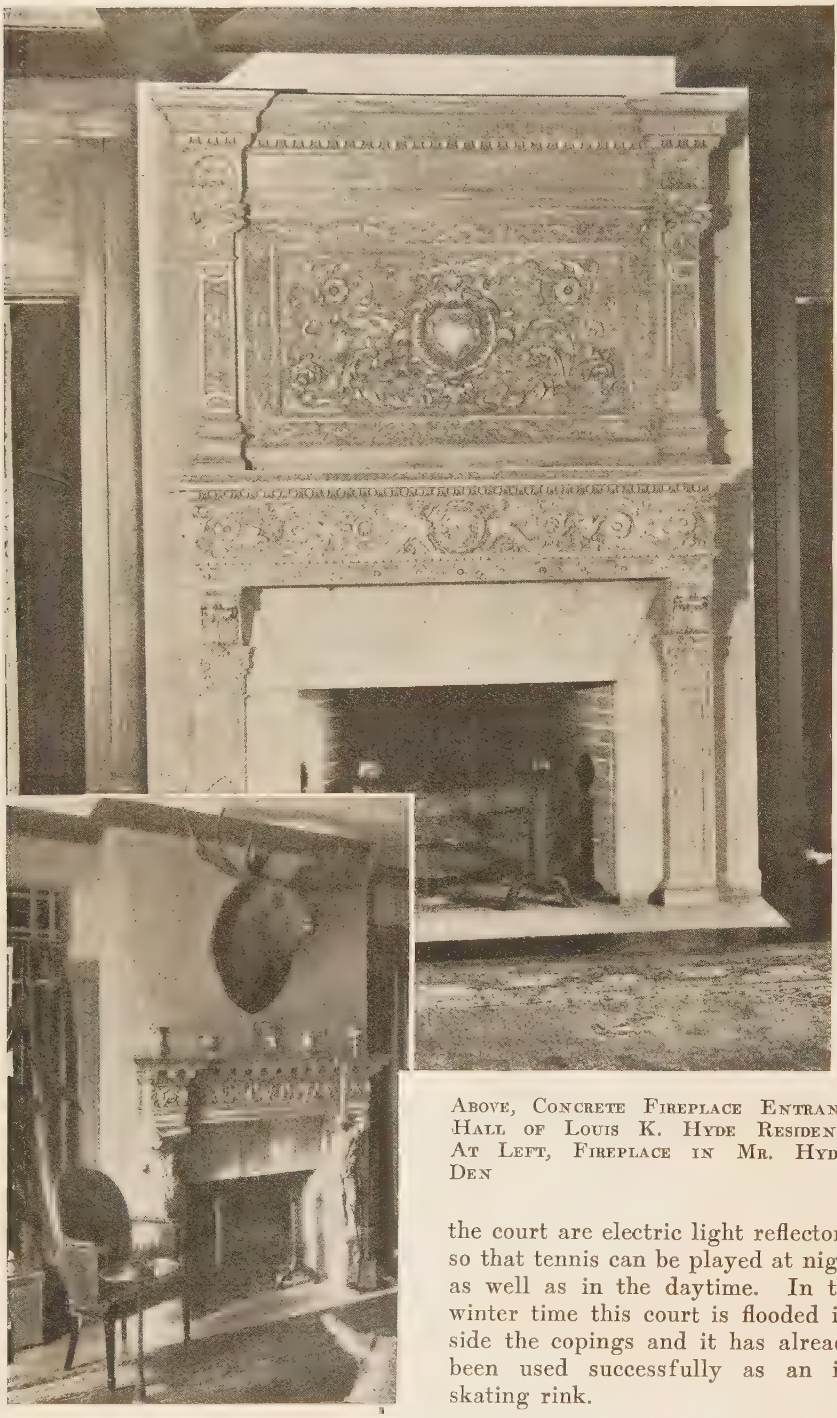
[2] Clinton Wire Cloth Co., Clinton, Mass.

[3] Atlas Portland Cement Co., N. Y. C.

[4] Rochette & Parzini, N. Y. C.

[5] Jacobson & Co., N. Y. C.

[6] Erkins Studios, N. Y. C.



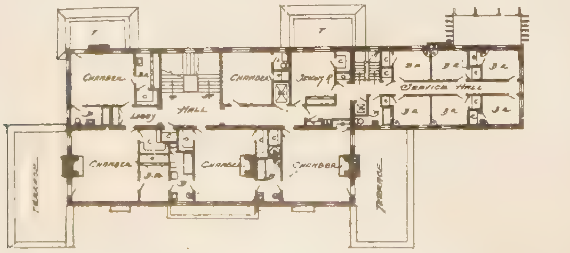
Above, Concrete Fireplace Entrance Hall of Louis K. Hyde Residence. At Left, Fireplace in Mr. Hyde's Den

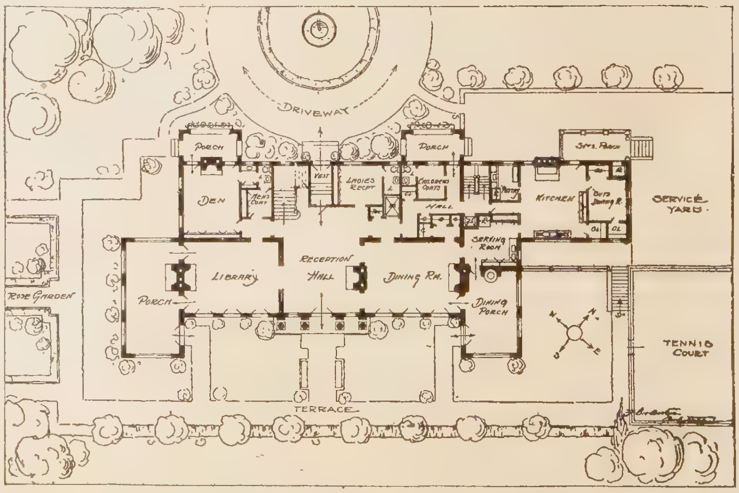
the reinforced concrete floors were built, with heavy Clinton wire mesh and twisted rods. It was made in sections with expansion joints. The coping around the court is of concrete and in the coping were left holes to receive the supports for the heavy wire mesh enclosure. Around the court are electric light reflectors, so that tennis can be played at night as well as in the daytime. In the winter time this court is flooded inside the copings and it has already been used successfully as an ice skating rink.

A Slogan for a House-Building Specialist

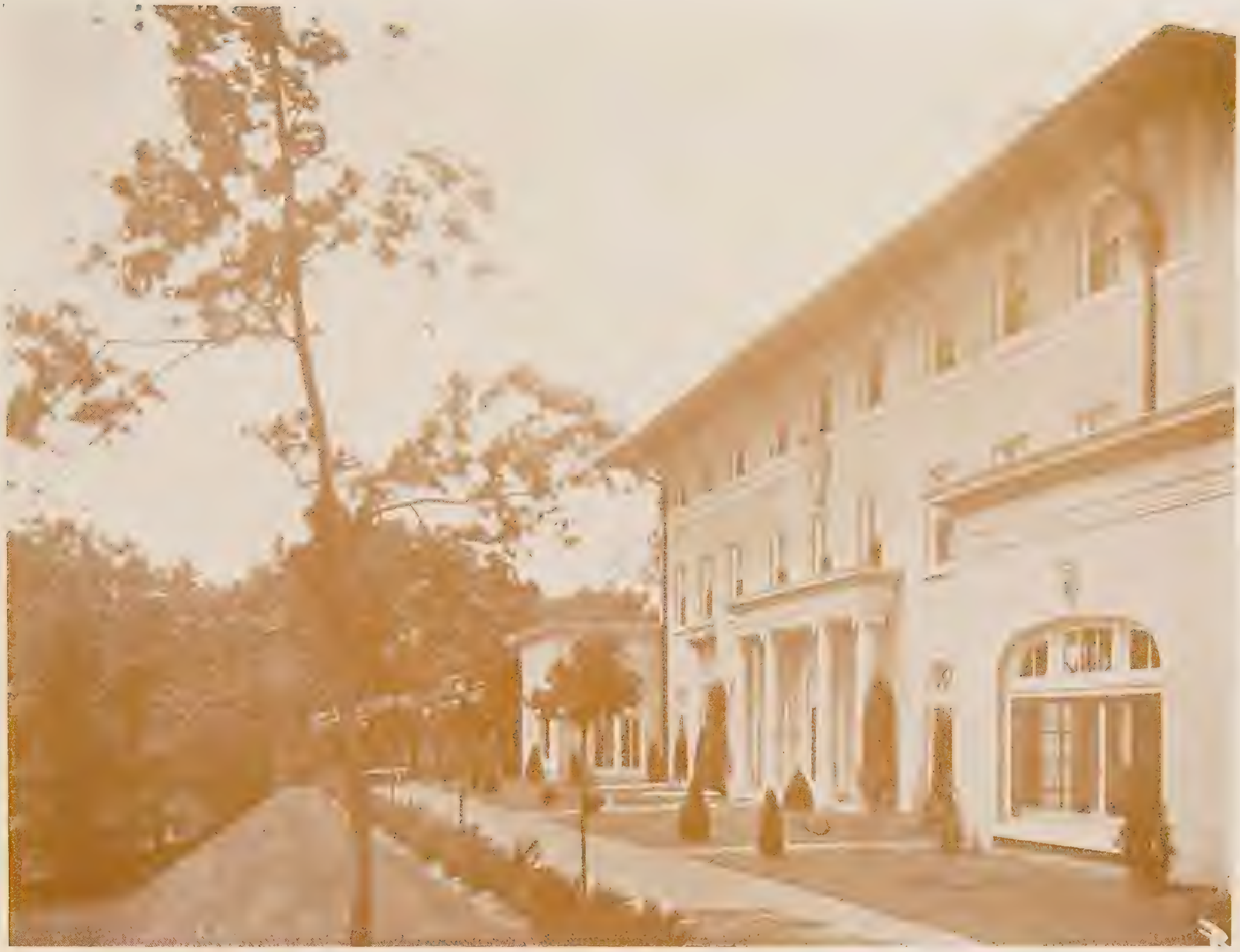
It would seem that having built two or three attractive, moderate-priced houses a builder could, by seeing to it that his name was associated with the idea of good service—work well done—an eye to the owner's interest and all the other things that are understood by the term good service, build up a specialist's business in a line on which his name — by advertising — would signify something. A builder who followed such a course should not fail to have his name permanently and continuously associated with his work. Let that name stand so unmistakably for a certain kind of work, that *work* and *name* become associated. The foundation for such a plan of campaign is in a few jobs particularly well done—a few satisfied owners. Let the public learn such a slogan as this: *"Smith-Built* Concrete Houses—for Permanence."

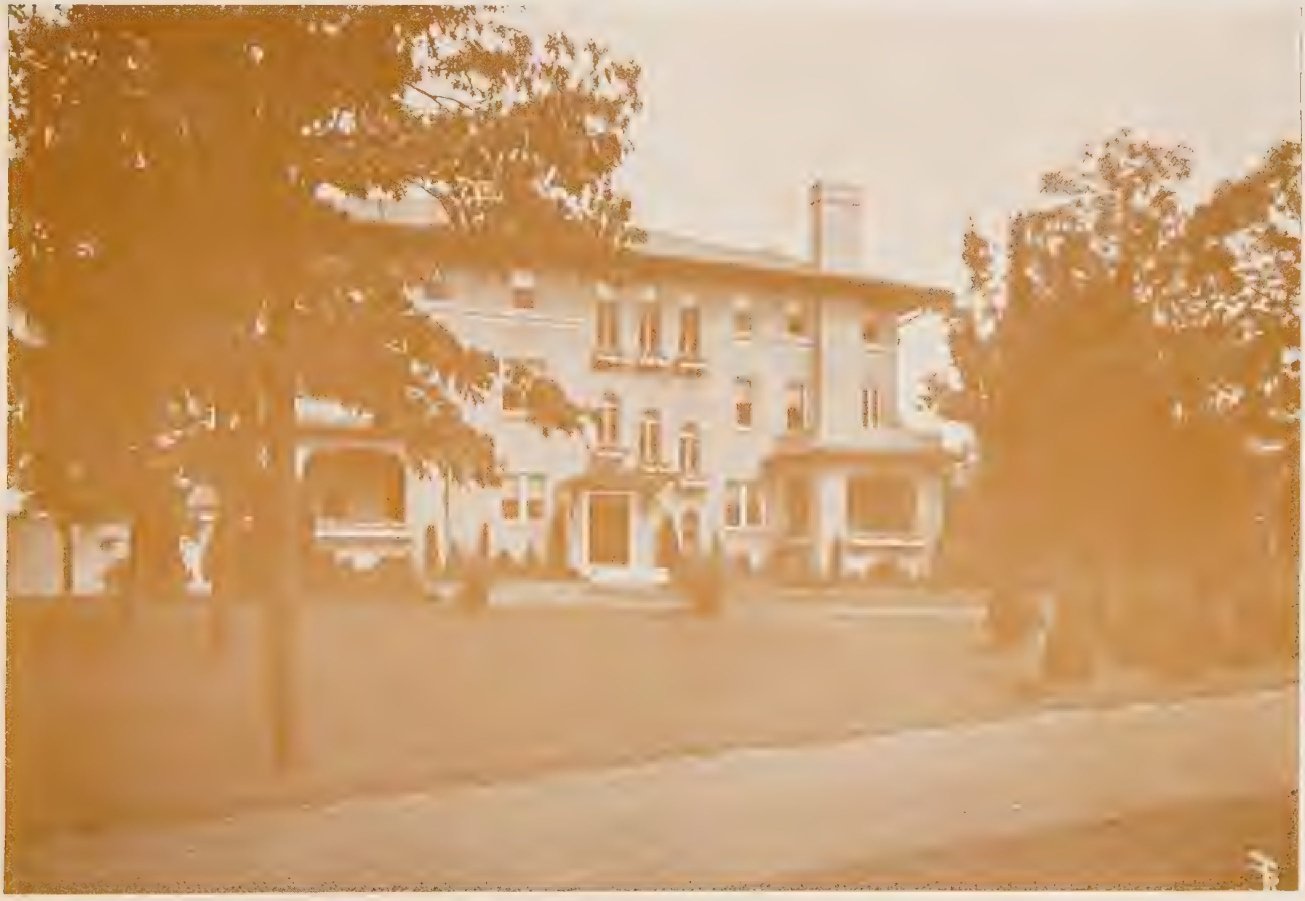
Getting a fireproof house for permanence and comfort at a cost little or no more than the cost of inflammable construction which requires continuous expenditure for upkeep depends chiefly upon the ingenuity of architect and builder. There are accounts in this book of the exercise of such ingenuity. *Common knowledge* of the methods by which low-cost concrete houses are produced does not exist in the sense that there is a great deal of common knowledge of carpentry and masonry methods. Ingenious individual builders—frequently building houses for themselves in dull seasons—are gradually adding to the store of knowledge.



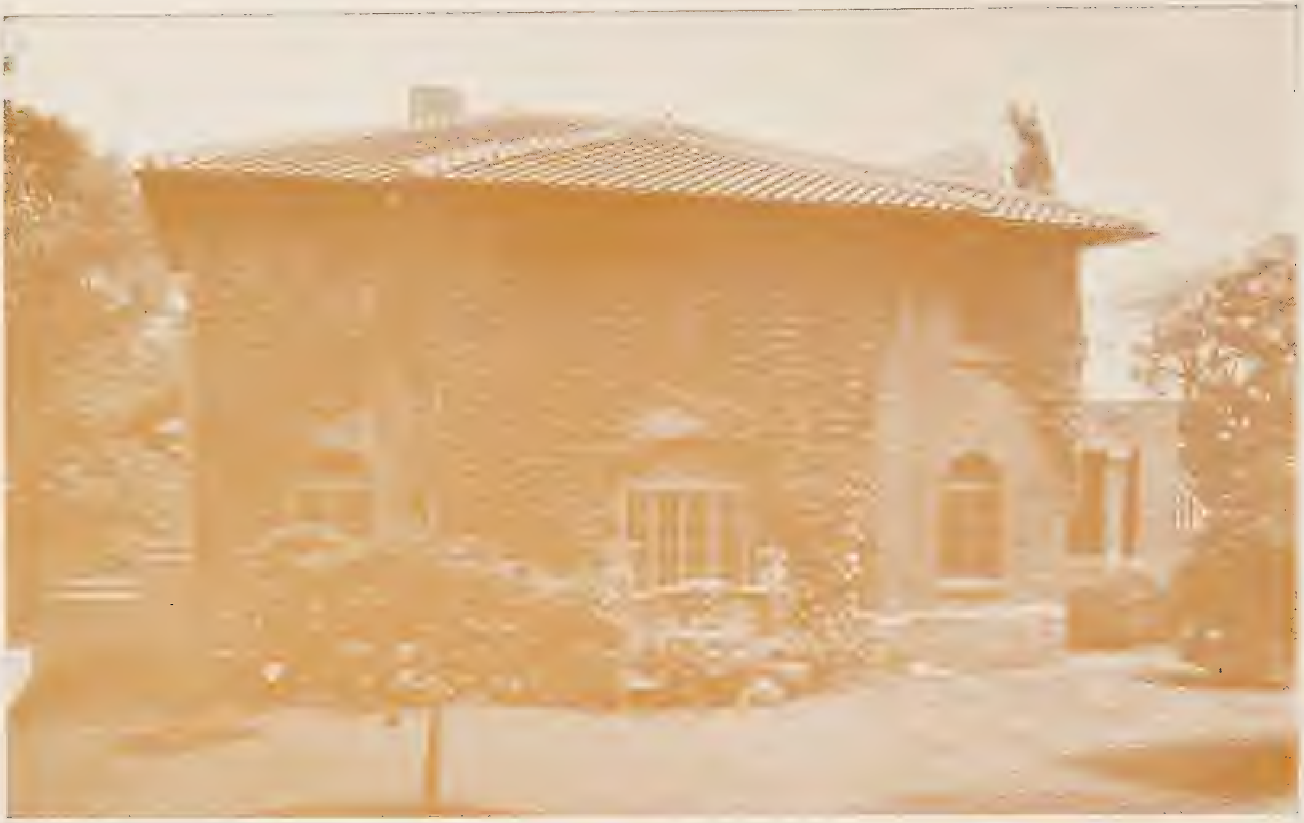


Second Floor Plan and First Floor Plan, Hyde Residence (Scale 1/56" to 1')





Two Views, Residence of Louis K. Hyde, Plainfield, N. J., Franklin B. Ware and Arthur Ware, Architects



Residence of Albert Moyer

Eight Years of Nature's Work on Concrete House at South Orange, N. J.[1]

Three illustrations of the home of Albert Moyer, at 324 Ridgewood Road, South Orange, N. J., are shown at this time, not because the house is new, but because it is relatively old among concrete houses. It was built in 1907 and is a most interesting example of the way in which a concrete house, when carefully built, fits into a landscape and comes in time to furnish a beautiful background for the draperies of nature.

The walls are of solid concrete and are not faced, as might be supposed, but are of like quality of concrete throughout. The aggregate was carefully selected to give a certain effect in the finished work and instead of having a plaster or a stucco surface the concrete was scrubbed and cleaned to expose the aggregate immediately after the removal of the forms. This concrete was composed of 1 part cement, 3 parts limestone and white marble, the size of sand, and 1 part ¾-in. trap rock, giving a good color variety. There is a great deal of exterior tile decoration which, however, is unobtrusive, as the colors of the tile inserts are primitive, pastel shades in low tones. All the tiles were hand-made and were burned in a primitive manner. The lines of the house are very simple, almost severe, yet this severity of line is fully compensated for by the richness of the entire concrete surface, and now after the lapse of a number of years it is further enriched by the shrubbery and the vines.

The house is 42′ wide, not including the loggia, and 55′ deep. The windows are casement made, with English leaded glass. The roof is of Japanese pan tile, run of kiln, and some of the tiles are smoky red, others salmon, and all the various shades are mixed together, giving a most pleasing result. The architects are Tracy & Swartout, N. Y. C.

Wood forms are sometimes lined with sheet metal or canvas to produce an even surface.

Salt should not be used in concrete where efflorescence or discoloration would be objectionable.

Sack Sense

A sack that carries its contents from the mills of the manufacturer to the ultimate purchaser, that is properly untied, that is kept clean and dry, that is not used as a covering for concrete nor as a toolchest, nor as a knee, foot or back protector, nor as a hod-pad, nor as a shoe cleaner and that, having thus once served its legitimate purpose, finds its way back to the mills of the manufacturer within a reasonable length of time—such a sack is again available for use and is worth the sum of 10 cts.

A sack that, upon its arrival at the job is opened with a shovel, that is used to plug holes in the water barrel, that is used as a sun-shade for concrete in summer and as an overcoat in winter, that likewise serves as a workman's apron or tool receptacle, and that is commissioned for other miscellaneous purposes just because it is handy, that becomes dirty, wet and even torn in places—the value of such a sack has reached the zero mark and, consequently, the needless labor of collecting, sorting, counting, bundling and tying sacks so improperly used should be avoided and the freight on their return saved by the man who purchased and used the cement.—*Dealers' Record.*

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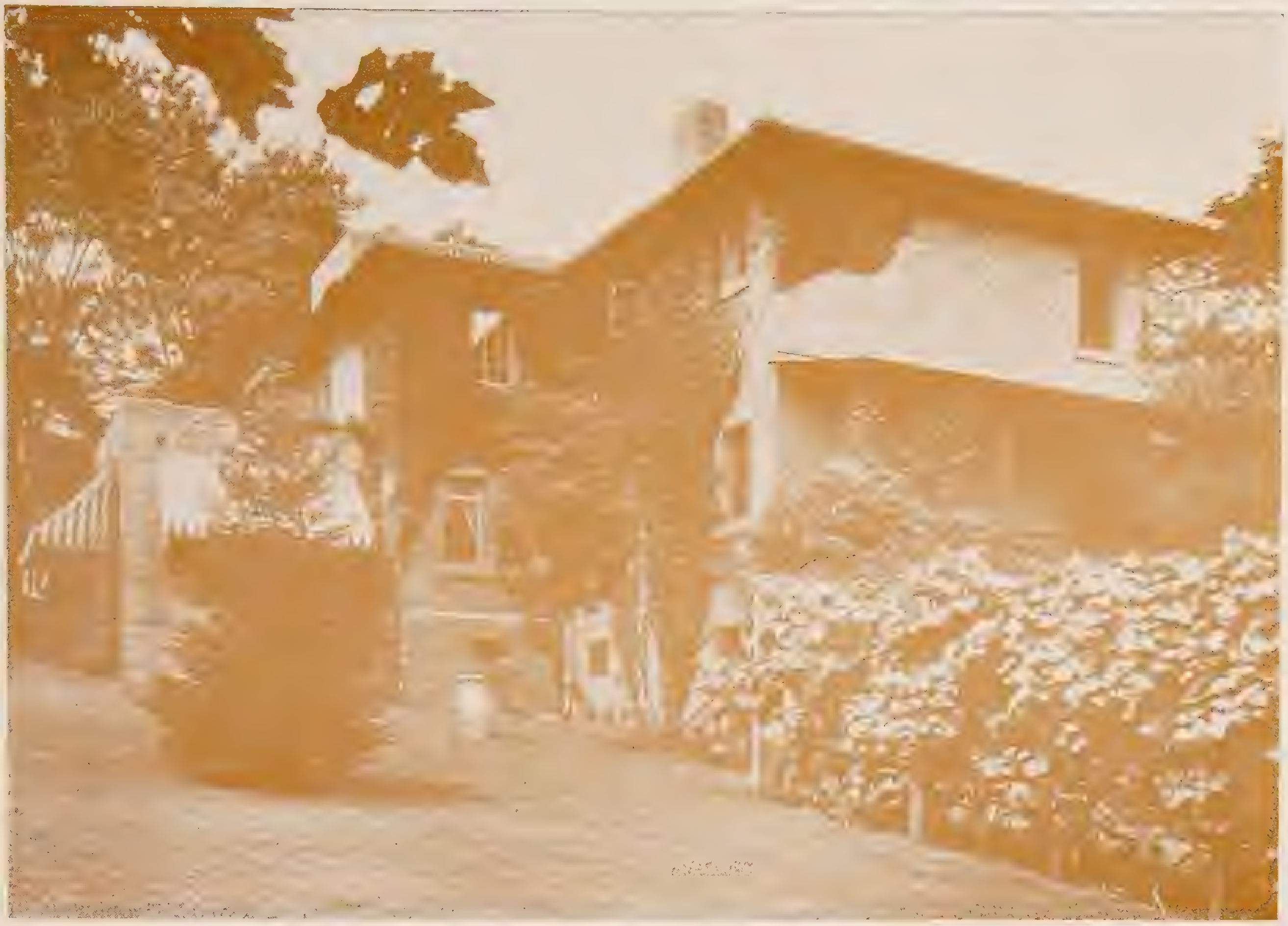
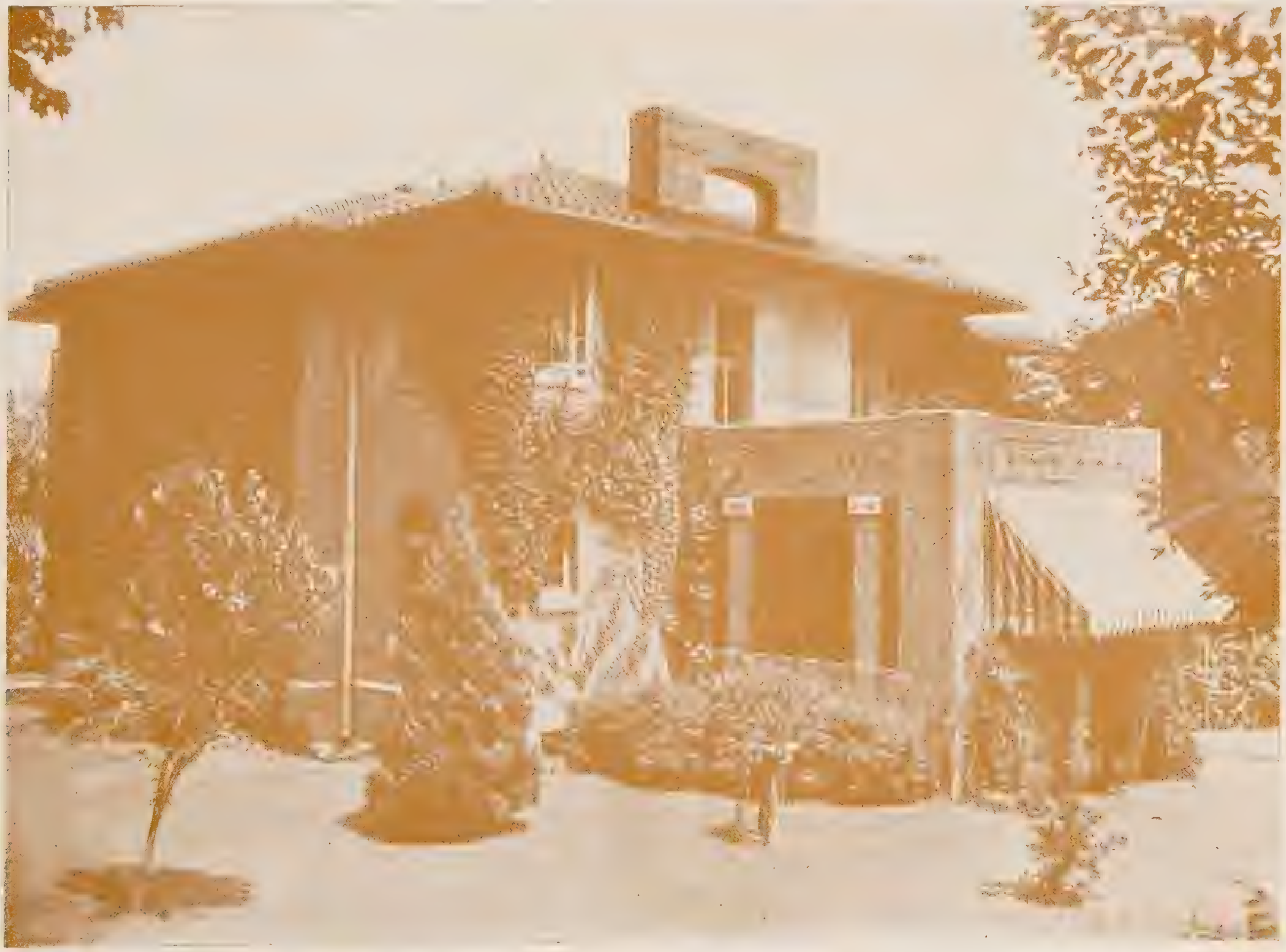
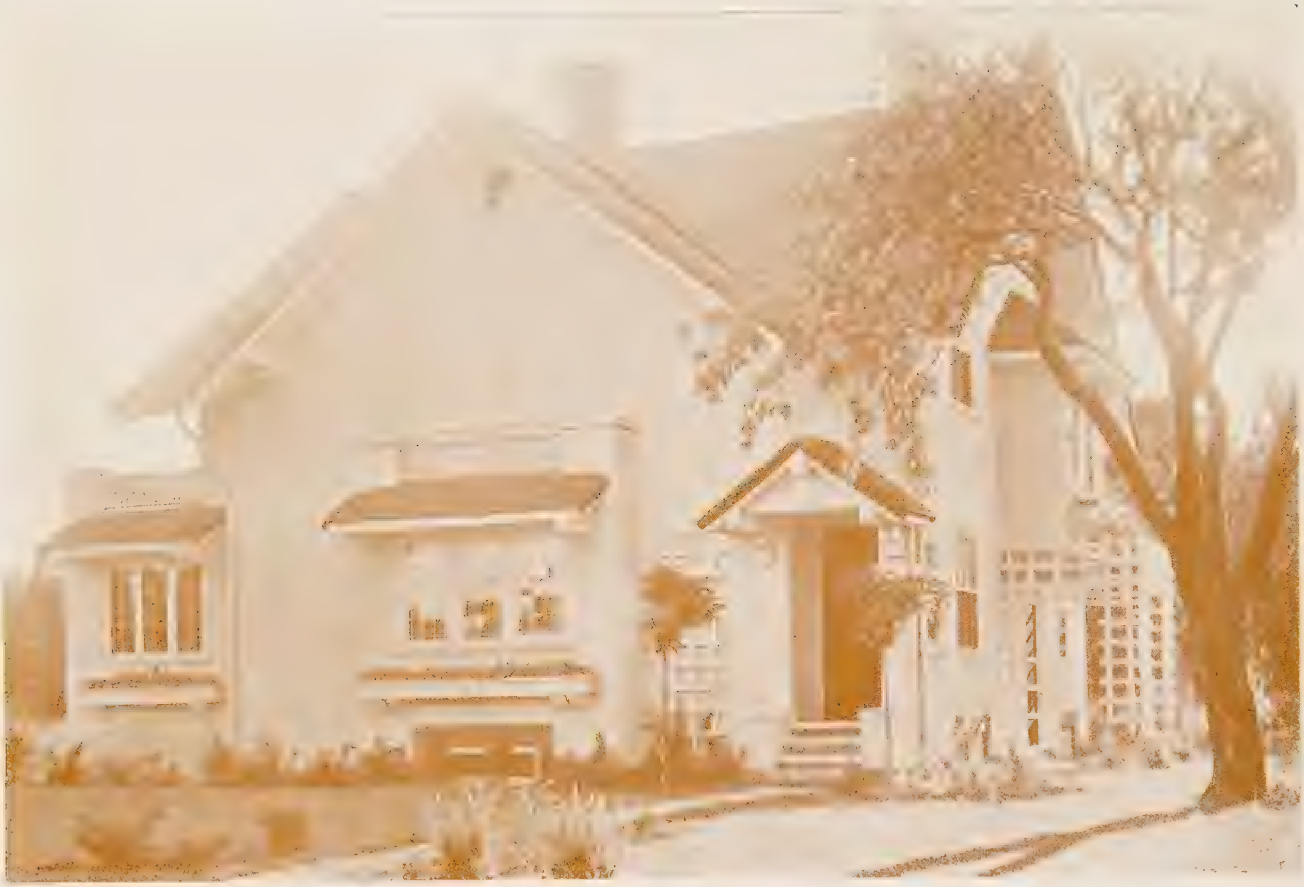
[1] From Concrete, Jan., 1916, p. 8

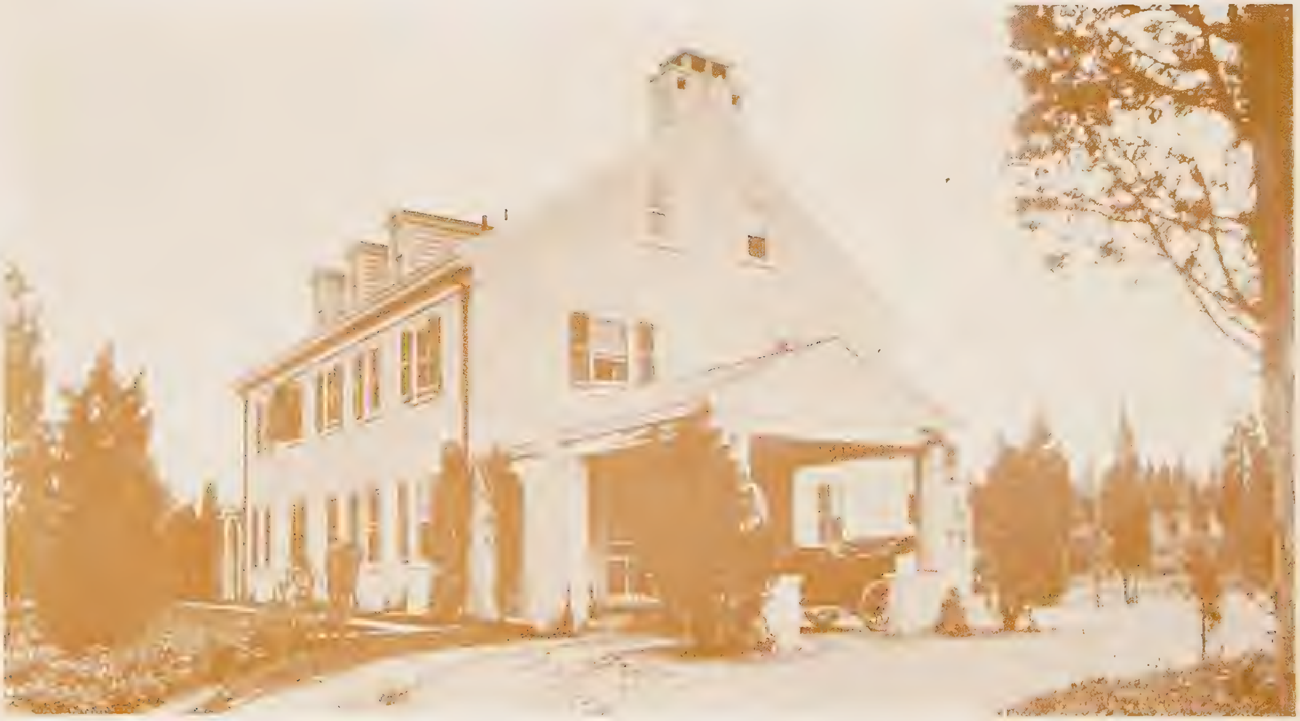




Two Views, Concrete Residence of Albert Moyer, 8 Years After Construction



Residence of William E. Schulzke, Architect, Moline, Illinois. Stucco on Metal Lath,



Residence at New Canaan, Connecticut, of William A. Boring, Architect, New York City. Poured Concrete With Concrete Floors.

Attractive House of Stucco on Frame Built for an Architect[1]

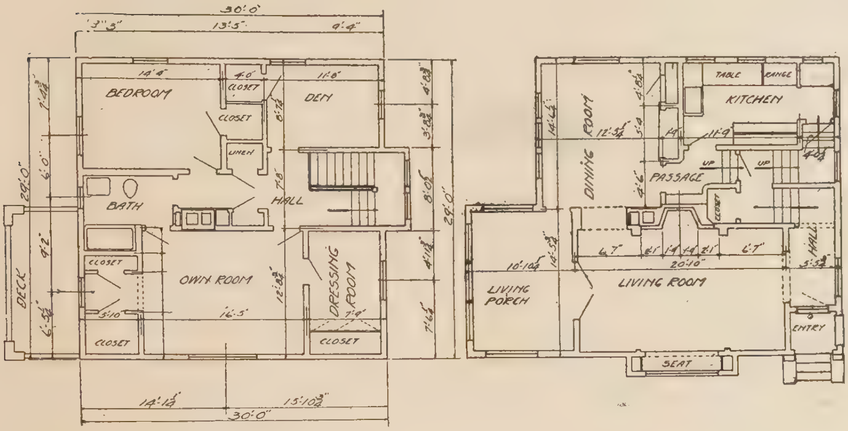


Fig. 1—Floor Plans, William H. Schulzke House, Moline, Ill.

(See illustration from photograph on opposite page)

The house which William E. Schulzke, architect at Moline, Ill., built for his own occupancy is shown in some of its interesting features in the accompanying illustrations from the architect's drawings. An illustration from a photograph showing the completed work is reproduced on another page.

It is a stucco house on wood frame. A heavy waterproof building paper was placed over the sheathing, then 2-in. by 2-in. furring strips were put on 12" o. c. The metal fabric is 24-ga., painted, ingot iron, expanded metal. On this three coats of stucco were applied. The first coat is put on thin to get a perfect key over the lath.

The second coat is a thin coat of cement plaster, and over this is placed a waterproof stucco thrown on with a paddle. This waterproof stucco is a commercial product made with crushed stone and waterproofed white Portland cement.[2] Mr. Schulzke says that the waterproofing is important in the stucco work because experiments have shown him that constant wetting and drying in ordinary cement stucco soon disintegrate it and cause trouble. Mr. Schulzke is a strong believer in the 2-in. by 2-in. furring trips rather than the thin furring strips in which dependence is placed on the building paper or the sheathing coming closer to the metal lath to key the plaster. He prefers to cover his lath by a careful application of the stucco and to have additional air space which the 2-in. by 2-in. strips afford. He breaks up these air spaces by having occasional headers run across in the height of the work so as to stop the circulation of air. Mr. Schulzke says that the house is very comfortable both in winter and in the summer months.

Mr. Schulzke's house is very complete in many respects, although he plans an addition to give him a library and additional bedroom space, bath room and servant's room. The house is equipped with a vapor heating system and is piped for a vacuum cleaning plant. One ingenious device is in connection with the window boxes, which are watered by a pipe controlled from inside of the house. The house as it stands, the architect reports, cost $6,500.

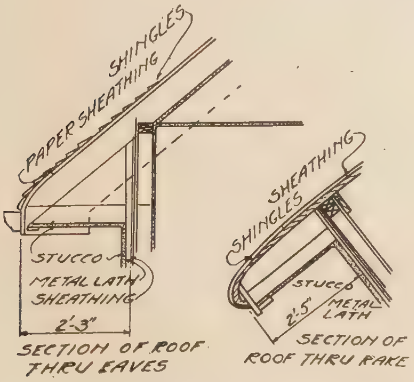
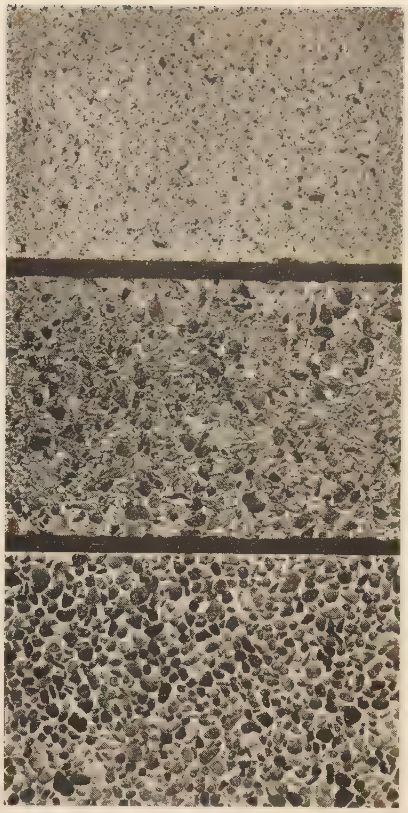


Fig. 2—Front and Side Elevations

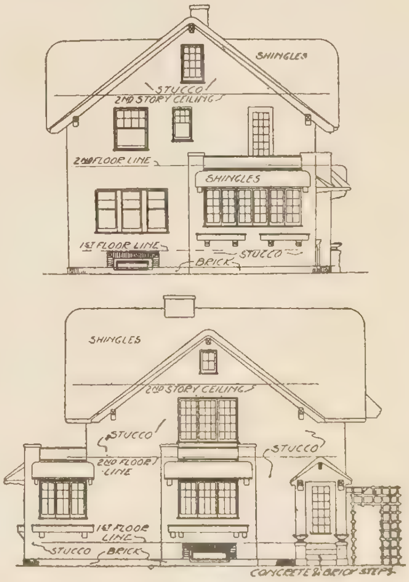
Fig. 3—Roof Details, Schulzke House



Concrete Surfaces of Selected Aggregate

The illustrations give a suggestion of the pleasing results gained by the use of aggregates of selected colors exposed by brushing the concrete before it is too hard. Note the varied textures obtained by different sized grains.

Where under surfaces of slabs are to be plastered, a scattering of coarse sand or fine gravel on the forms will result in a surface insuring a better bond.



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[2] Beder Woods, Moline, Ill., using Medusa cement of Sandusky Portland Cement Co., Cleveland

[1] From Concrete, Jan., 1916, p. 18

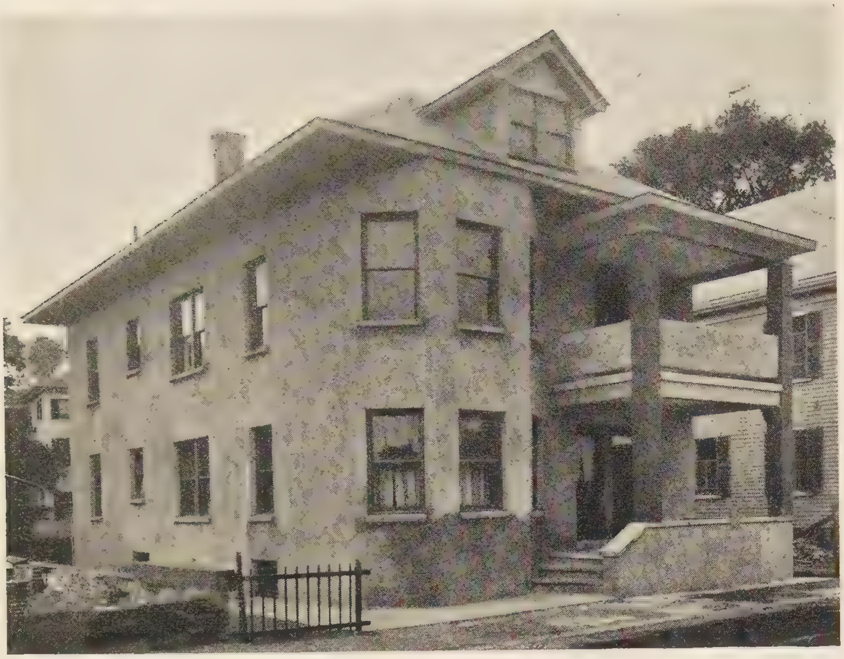

Fig. 1—Two-Family Concrete House

Typical Two-Family House Complies With Salem's Strict Building Code[1]

By C. D. Gilbert[2]

A conflagration of the proportions of that at Salem, Mass., turns the attention of the home builder to fire-resisting materials. Salem has "come back" in a way that reflects credit on her people. Needless to say, the present building code provides rigid restrictions designed to prevent the spread of future fires. Some of the provisions respecting residence construction are:

1. The abolition of shingle and composition roofing, with the requirement that all cornices and dormers shall be covered with fire-resisting material.
2. Provision for exceptionally efficient fire stopping of frame walls and partitions.
3. Provision for ample stairways and insulation of heating apparatus and chimneys.

While the provisions adopted by the building commission seem to some to work hardship, a study of modern building materials and methods has demonstrated that the comparatively small outlay required to comply with the law is really an economy due to greater permanency.

The result of forced building operations and the efforts of those interested in furnishing building materials was to give the people of Salem an unparalleled opportunity to study modern construction materials. A trip through the city reveals almost every type of residence construction.

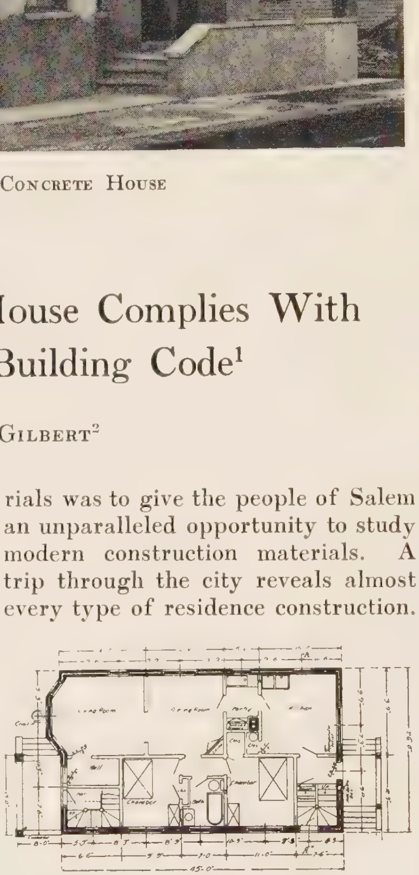

Fig. 2—First Floor Plan

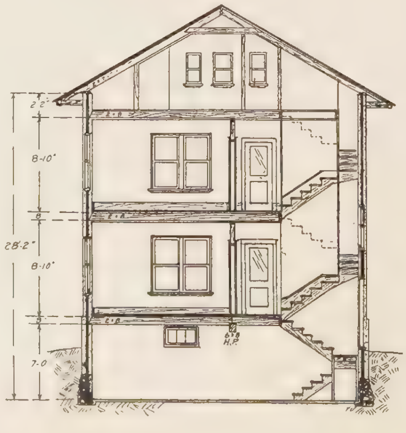

Fig. 3—Section at A-A Through Rear Hall

GENERAL FEATURES

The house described in this article contains a number of interesting construction details. The outer walls are of concrete of what has become popularly known in Salem as thermos bottle construction. This consists of double reinforced concrete walls separated by a 2½-in. air space erected with a hollow wall machine,[3] but the interior is of frame construction. The front and the rear porch are of concrete. The cornice is of stucco on metal lath, the roof structure of slate on frame. The chimney is of concrete with a square vitrified clay flue lining.

An inspection of the plans will show that the house is a typical two-flat building, each flat containing five rooms and bath, while provision is made for two extra rooms and storage space in the attic. The house is equipped with a steam heating plant, the owner heating both flats. Electric lights are used and gas is piped to the kitchen, although provision is also made for a coal range. The floors and the trim are of selected North Carolina pine.

CONSTRUCTION

As this house was built on the site of a burned structure there was a considerable amount of stone from the old walls available in the excavation. It was decided, therefore, to make use of these stone and the old walls were tumbled into the middle of the cellar and the excavation trimmed to a proper size. The first floor joists were utilized as forms and set up one plank high at a time around the excavation. Concrete was then deposited back of the forms and the stone were carefully bedded in the concrete. Other planks were added as needed until the stone available was entirely used, which made a solid wall 2′ wide at the base and about 3′ high. On top of this rather massive footing the double wall construction was started with the hollow wall machine. A 4-in. inside wall and a 6-in. outside wall was used for the remainder of the basement so as to provide a water table (Fig. 3). When doing this part of the work, owing to the stone piled in the cellar and to obstructions on the surface of the ground, it was impossible to handle concrete by means of wheelbarrows. A wire cable was therefore hastily rigged over the excavation as a miniature cableway system and heavy galvanized buckets attached to the trolley were readily carried practi-

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[1] From Concrete, Jan., 1916, p. 24

[2] Assoc. Editor of Concrete

[3] Van Guilder Hollow Wall Co., Rochester, N. Y.

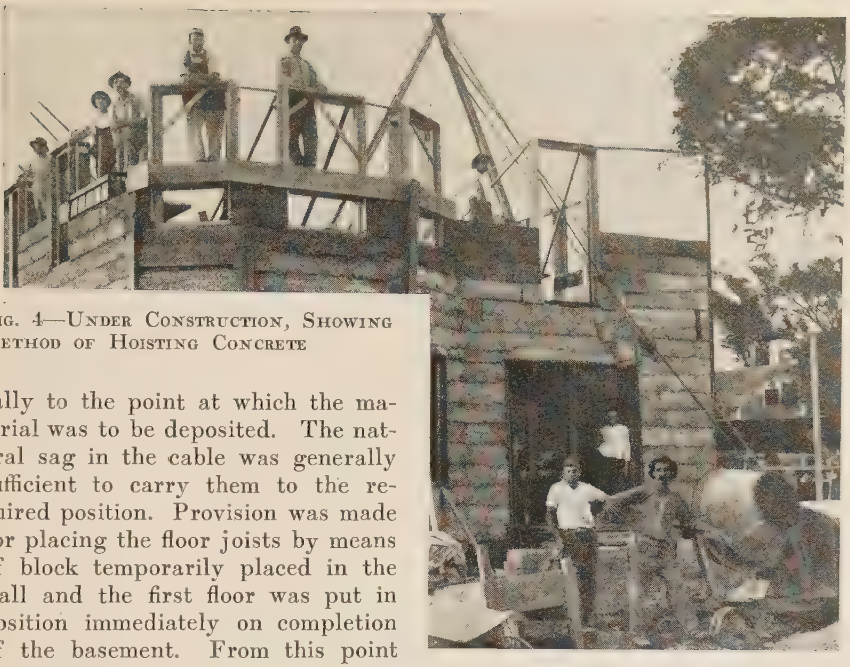

Fig. 4—Under Construction, Showing Method of Hoisting Concrete

cally to the point at which the material was to be deposited. The natural sag in the cable was generally sufficient to carry them to the required position. Provision was made for placing the floor joists by means of block temporarily placed in the wall and the first floor was put in position immediately on completion of the basement. From this point the concrete walls were in two 4-in. sections.

HANDLING CONCRETE

Concrete for the first story was handled by means of a runway by which it was wheeled in pails to the floor and passed to the staging, to be placed in the walls. On this class of work it is found that it is cheaper to handle concrete in buckets than to provide the necessary runways for wheeling small quantities widely distributed. After the first floor was in, a wire cable was rigged from the mixer over an A frame on the second floor and three buckets hoisted at a time by means of a small gasoline hoist which was a part of the mixer outfit.[4] The building was staged by means of 3-ft. saw-horses, substantially made, and these were used again on subsequent work. The second stage was provided by means of extensions which were put on the horses and made secure by means of light stays. This arrangement permits rapid and very economical work. The second staging is high enough to complete a story height.

Concrete Material—The aggregate available was bank-run sand and gravel. The quality and grading were not all that could be desired, but a 1:5 mix resulted in an excellent concrete.

PORCHES

The front and the rear porch are of concrete, but brick columns were used in front to add a touch of color to the building. The porch walls were built with the wall machine and a plain cap used as finish. Brick on edge at window sills give another color note. All porch floors and steps are of concrete. A detail of the form work and reinforcing for the front second floor porch is shown. Reinforcement consists of 2 3/4-in. rods, trussed, in the beam and 1/2-in. rods 16″ c. to c. each way in the slabs. This reinforcing seems excessive but consisted of scrap rods of doubtful quality, which were available at low cost. The porch roof was designed to be of reinforced concrete, but was changed to frame construction with cornice and ceiling of metal lath. It is believed that had the original plans been carried out the roof would have been more permanent without being any more expensive. This roof is covered with tin and drained through one of the brick piers. The second floor porch slab was waterproofed with a layer of pitch between the structural slab and the top surface.

DETAILS

The chimney, which contains two 8 x 12 flues, is built of concrete. Two sets of forms 3′ high were made substantially as is a column form, and filled each day. As each 3-ft. lift was added the forms below were taken off, to be used again higher up. The vitrified flue linings acted as the inside form. Reinforcement was used, consisting of odd lengths of wire and iron forming hoops at intervals of about 1′. Chimney construction kept pace with the walls and was very economical. Brick was used above the roof, making a more convenient means for flashing and worked out well with the brick porch columns and window sills. Bearing partitions were fire stopped with concrete at each floor level according to the building code, being filled solid from the girder or partition cap on which they rest to a point 5″ above the floor level. The same fire stopping is required at each floor level in walls of frame buildings. Cornice construction, as shown by the details, is of a metal covered fascia and a metal lath and plaster soffit. The method of making a satisfactory joint between the concrete wall and the metal lath is indicated by the details. The exterior finish consists of two coats of cement mortar and rough-cast finish.

The inside plastering was done directly on the concrete walls, which are thoruoghly insulated by the air space. The two dormers are of frame construction, the sheathing being furred and covered with metal lath. The metal lath extends to the roof sheeting so as to form a fire stop at that point. The roof was covered with a good quality of green slate.

The window frames were of special design and would be economical when made in quantities, although a premium was paid for those used on

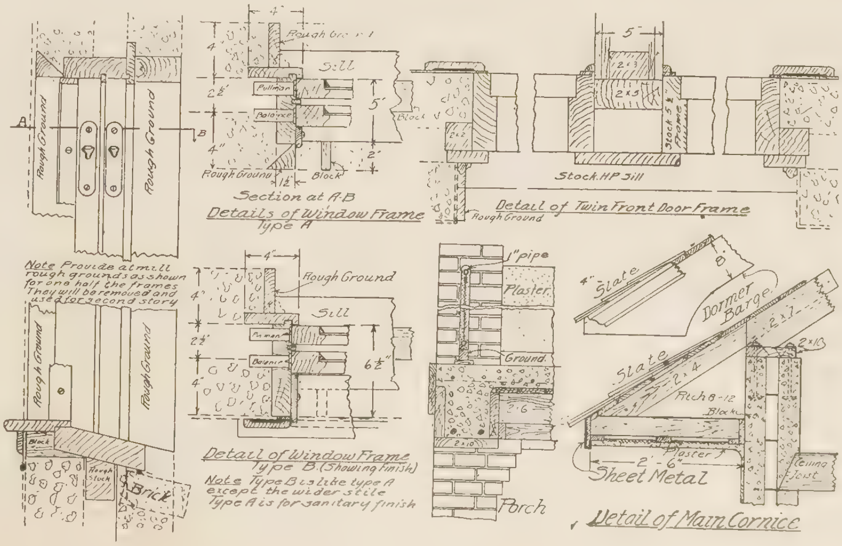

Fig. 5—Details

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[4] Jaeger Mach. Co., Columbus, Ohio

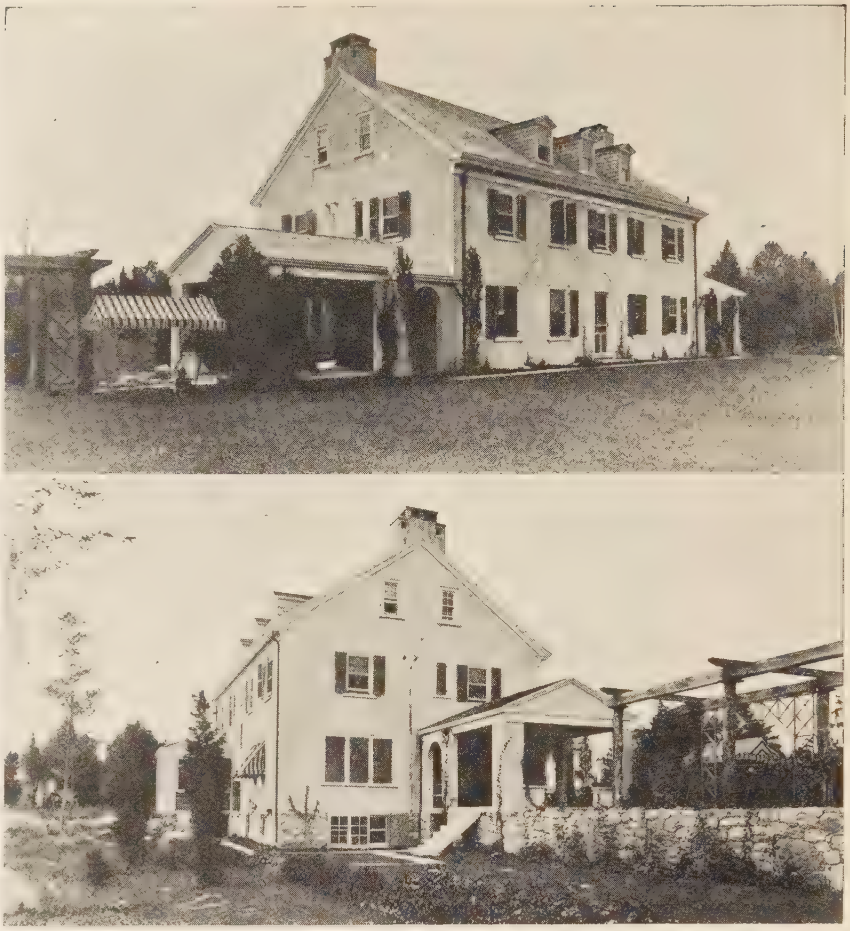
this particular house. As will be seen by an inspection of the details, the kitchen, bathroom and rear halls were not provided with the usual window trim; instead, a rough triangular strip was used which formed the concrete into such shape that the plasterer was able to form rounded sanitary trim. Throughout the remainder of the house the usual type of trim was placed as shown by the detail. Pullman balances[5] were used, which did away with the necessity for box frames. The balances are protected from the concrete by means of pressed steel housing, which is supplied for concrete work. This balance is very effective and does away with weights and cord.

COST

In considering the cost of this house it must be remembered that no one connected with the job except the foreman had had previous experience with the machines used or with concrete construction. The workmen employed had been previously engaged in another line of work. It is not surprising, therefore, that under these circumstances the costs were somewhat more than would be the case in duplicating the house, although these conditions were partially offset by the low cost of labor. The builder itemizes the cost as follows:

Surveying	$ 25.00
Labor, including excavating, concrete and rough carpentry..............	1,294.11
Cement, sand, lime, hair............	413.79
Lumber and millwork..............	1,497.48
Brick work	46.70
Plastering	402.79
Slating and sheet metal............	220.60
Doors and windows................	150.13
Window balances	52.70
Finished carpentry labor...........	384.00
Plumbing	424.55
Heating	313.47
Electric wiring	71.00
Electric fixtures	58.70
Painting	205.00
Hardware and sundries, as reinforcing wall ties, gasoline, flue-lining, express, bookkeeping, telephone, carfare	339.97

The house was built by P. Creedon, Salem, for T. J. Maroney. It was designed by the author and erected under his direct supervision.



Figs. 1 and 2—Two Views of William A. Boring House, New Canaan, Conn.

An Architect's Own House With Concrete Walls and Floors[1]

By Milton Dana Morrill[2]

William A. Boring, architect, N. Y. C., selected reinforced concrete construction for his country residence at New Canaan, Conn., although a majority of the important works of the firm of Boring and Tilton have heretofore been carried out in brick and stone. They designed the great Immigrant Station at Ellis Island.

W. G. Wood, a progressive builder of Norwalk, Conn., had launched out into poured concrete for residence work, as he saw in this type of construction the greatest future. Mr. Boring watched the work going on and visited the concrete houses after their completion. He had to be "shown" and did not adopt concrete without due thought and consideration, and from cellar to garret in winter and summer he went through the houses which Mr. Wood had put up.

His friends, who knew nothing about it, told him that if he built a concrete house it would be damp, but fortunately he was in a position to judge for himself. He decided that poured concrete was the construction which he wanted, and as a result he has a permanent, fireproof house and he built it at a cost little in excess of that of the usual wood construction.

The plans here shown need little explanation, and the illustrations from photographs give one a good idea of the exterior design. As time goes on the house will become more and more attractive, as the trees, shrubs and vines, which Mr. Boring included in the architectural design, mature.

The house is of concrete throughout. The walls are 9″ thick in the first story, 7″ in the second, and 6″

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[5] Pullman Mfg. Co., Rochester, N. Y.

[1] From Concrete, Jan., 1916, p. 19

[2] Archt., Washington, D. C.

in the third, with reinforcement, generally of 3/8-in. rods 24″ o. c. The partitions are of concrete 6″ and 4″ in thickness. Both walls and partitions were poured by the use of steel forms;[3] the floors are of reinforced concrete of the floor-tile construction.[4] The slab thickness between the concrete beams is 2″. Beams are 8″ deep, spaced 20″ o. c. The house has a shingle roof, which would appear to be the only vulnerable part. The walls were furred for lath and plaster.

There are many individual touches about the house which must be seen to be appreciated. Living room, hall and dining room are all finished in chestnut paneling, which extends from floor to ceiling, stained a deep brown. For the second floor construction the forms were made of heavy chestnut plank laid over heavy wood beams all rough-sawed; the concrete floor slab was put over this but the wood framing and beams were left as a finished ceiling, all stained a deep brown like the side wall paneling. The effect is very pleasing. Wherever in the house there is plastering a sand finish has been given and the tool marks and trowel marks have been left to give texture to the finish. Hardwood floors have been laid over the cement slabs, except in the kitchen and the servants' quarters, where the floors have been left with a cement finish. The exterior walls have a rough stucco finish of white Portland cement and sand.

Besides the house there is a garage and cow barn, all built of poured concrete inside and out.

Figs. 5, 6 and 7—Construction Views, Boring House

At top, lifting a tier of wall plates; center shows window frames set in forms; bottom view shows offset for second floor bearing

The cost of the concrete in place, including all form costs, was about $6.50 per cu. yd.

Mr. Boring's house is a masterpiece of its kind. In its simplicity perhaps lies its greatest charm. One can picture how beautiful it will become as the years take off the new look and bestow that indescribable coloring and texture which time alone can give. It is also a modest example of the builder's skill in his desire and determination to improve his construction methods, and if only the public at large would realize what the real concrete house means this construction would take the place which it deserves as the best that can be built, regardless of price.

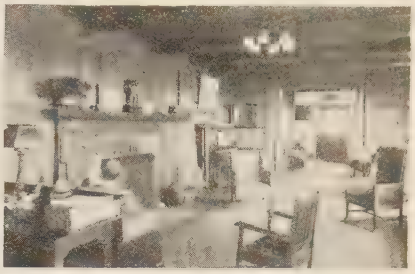

Fig. 8—Living Room, Boring House

Note Beamed Ceiling

Unfortunately, in this country we have become accustomed to building frame houses and about the only fire precaution taken is the fire insurance, which in no way prevents the tremendous yearly fire waste, but merely divides it among those who do have fires and those who do not. In the end the house owner pays the loss, anyway. The best way to insure is to build properly, and in a fire-proof material.

If we look at the ordinary frame house while it is building we can see that the woodwork looks almost "built to burn." If we wish to kindle a fire we space the pieces of wood much as the studs and beams are put together, and veritable flues are formed which cannot but spread the flames when once started.

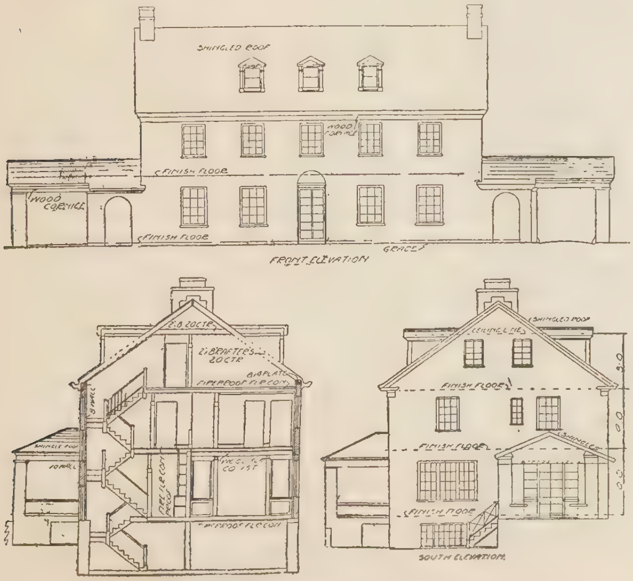

Fig. 3—Front and Side Elevations and Section

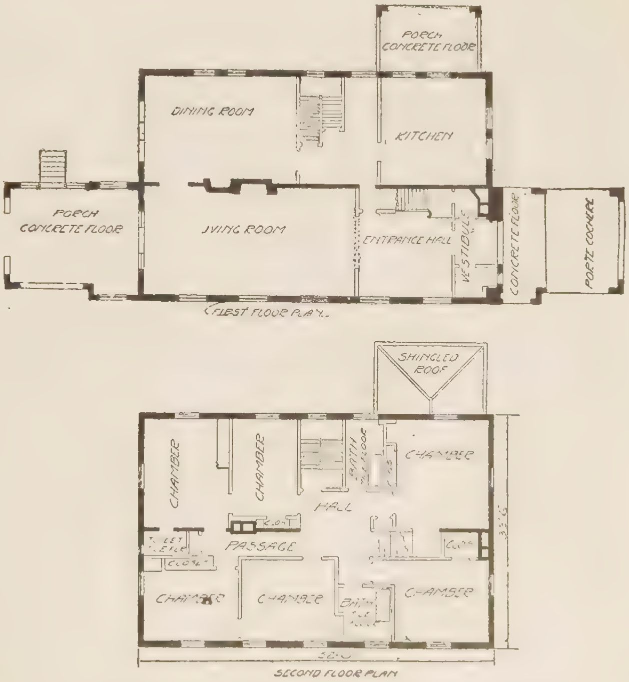

Fig. 4—First and Second Floor Plans, Boring House

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[3] Morrill system

[4] Trussed Concrete Steel Co., Youngstown, Ohio

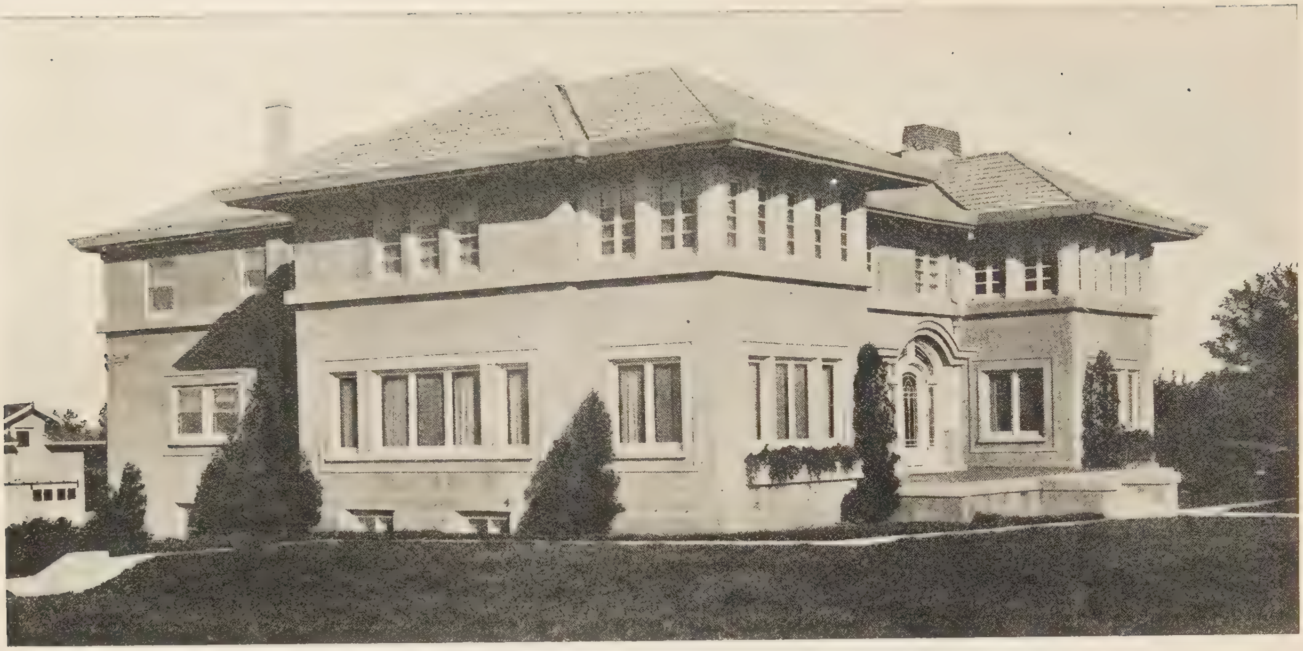

FIG. 1—RESIDENCE OF F. L. WILLIAMSON AT KANSAS CITY, MO.

An Example of Fireproof Residence Construction at Kansas City, Mo.[1]

The subject of this article is the residence of F. L. Williamson.[2] It was inevitable that Mr. Williamson's close contact with the cement industry should have impressed upon him the value of concrete as a residence material. The plans are by Shepard and Belcher[3] and the concrete structural features were designed by the Trussed Concrete Steel Co.,[4] which furnished the reinforcing material.

Study of the plans shows the house to be 68′ wide and 63′ deep. The basement is fully utilized, containing a fireproof garage, man's room, laundry and work room, besides space for the heating plant and for general storage. A reinforced concrete cistern occupies the entire space under the front porch. The feature of the first floor is the large living room, with its heavy beamed ceiling.

The first floor also contains a library, dining room, kitchen and two spacious porches. The second floor provides two large sleeping porches in addition to sleeping rooms.

It is obvious that in a building of this kind details must be very carefully planned in advance or considerable annoyance will occur. All electric wiring was located in conduits which were placed before pouring the slabs and walls. Chases were left for vertical pipes and conduits and such pipes as are subject to variations of temperature were carefully wrapped with asbestos paper and then insulated before the wall was plastered with cement mortar. The first and the second floor finish in the principal rooms is 1¼-in. oak nailed to strips embedded in the concrete. The kitchen and the servants' room, basement and third floor slabs are given a granolithic finish, as are also the basement stairs and the stairs from the second to the third floor. The enclosed porches are floored with Adamantile[5] and the open porch at the front is floored with red concrete tile 9″ x 9″, set with black mortar joints. It will be noted that this porch is really the roof of the 16-ft. x 32-ft. concrete cistern. The water from the cistern

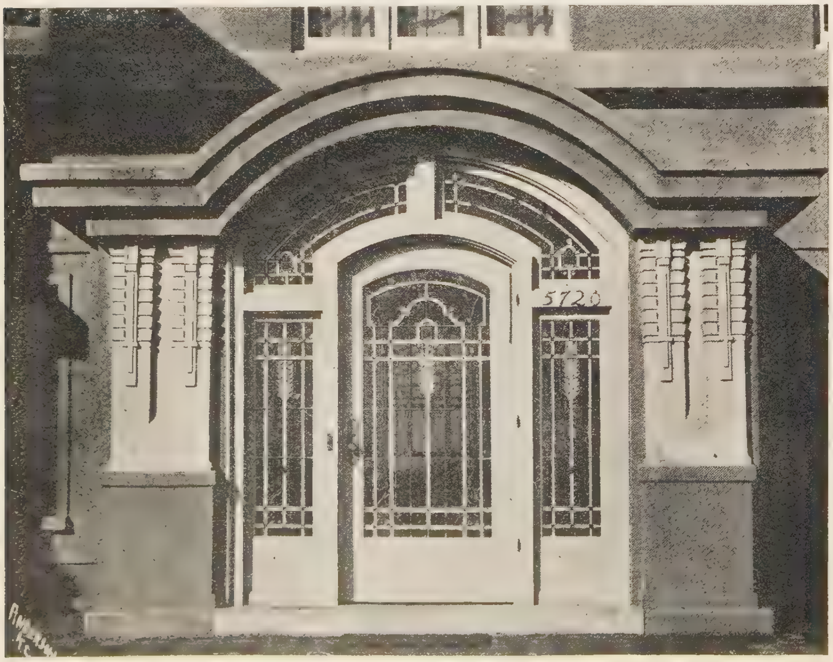

FIG. 2—ENTRANCE, F. L. WILLIAMSON RESIDENCE

is pumped by a lift actuated by city water pressure to a reinforced concrete tank in the attic. The attic floor slab forms the bottom of the tank. The ceiling of the library is furred and all ceilings are plastered with Keene's cement, but the walls are plastered with Portland cement mortar.

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[1] From CONCRETE, Jan., 1916, p. 14

[2] Vice-Pres. and Gen. Mgr., Dewey Portland Cement Co., Kansas City, Mo.

[3] Archts., Kansas City, Mo.

[4] Youngstown, Ohio

[5] National Mosaic Flooring Co., Mobile, Ala.

The exterior finish is stucco direct on the concrete wall, the rough concrete surface forming an excellent key. The body of the stucco is rough-cast, but smooth borders are left around the windows at the sides of the building, which give a very attractive finish. At either side of the main doorway and at the corner of the second floor sleeping porches ornamental cast stone were used, as can be best seen by an inspection of a detail of the main entrance, shown elsewhere in this issue. This ornamental work was cast on the job in plaster molds. The molds were set in place and the rough concrete placed around them, together with the proper reinforcing. The fire-place on the north porch is of Caen stone and extends from floor to ceiling. The fire-place in the Library has a Caen stone facing with a wood mantel.

INTERIOR TRIM

The trim of the first story is oak; the second story has white enamel and mahogany finish. The wall decorations are entirely of white lead and oil applied directly to the plaster. The windows are nearly all casements, opening out.

CONSTRUCTION

Work was started Oct., 1914, and the building was completed ready for occupancy the first week in July, 1915.

Reinforced concrete footings 12″ deep were placed under all walls. On this footing, work was started with hollow wall machines,[6] building a 4-in. outside and a 6-in. inside wall with a $2\frac{1}{2}$-in. continuous air space. As will be seen by the illustrations, the front of the house has a very heavy water table extending well below grade. This projection was built with the hollow wall machine by running the inside wall first and then going over the wall a second time with a wall machine having the core removed and building a 12-in. wall at the proper height. The machine was set back 4″ to form the double water table effect and later another 4″ to bring it to the final wall thickness. Flower boxes were cast on this base under the windows in the two front porches.

Floors — Basement walls were brought to the level of the bottom of the first floor slab, the outer wall being continued to the top of the slab, the inner wall being lower by the thickness of the slab. Forms were then placed and the first floor poured. It will be noted that the main partition in the basement and at the end of the living room in the

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[6] Van Guilder Hollow Wall Co., Rochester, N. Y.

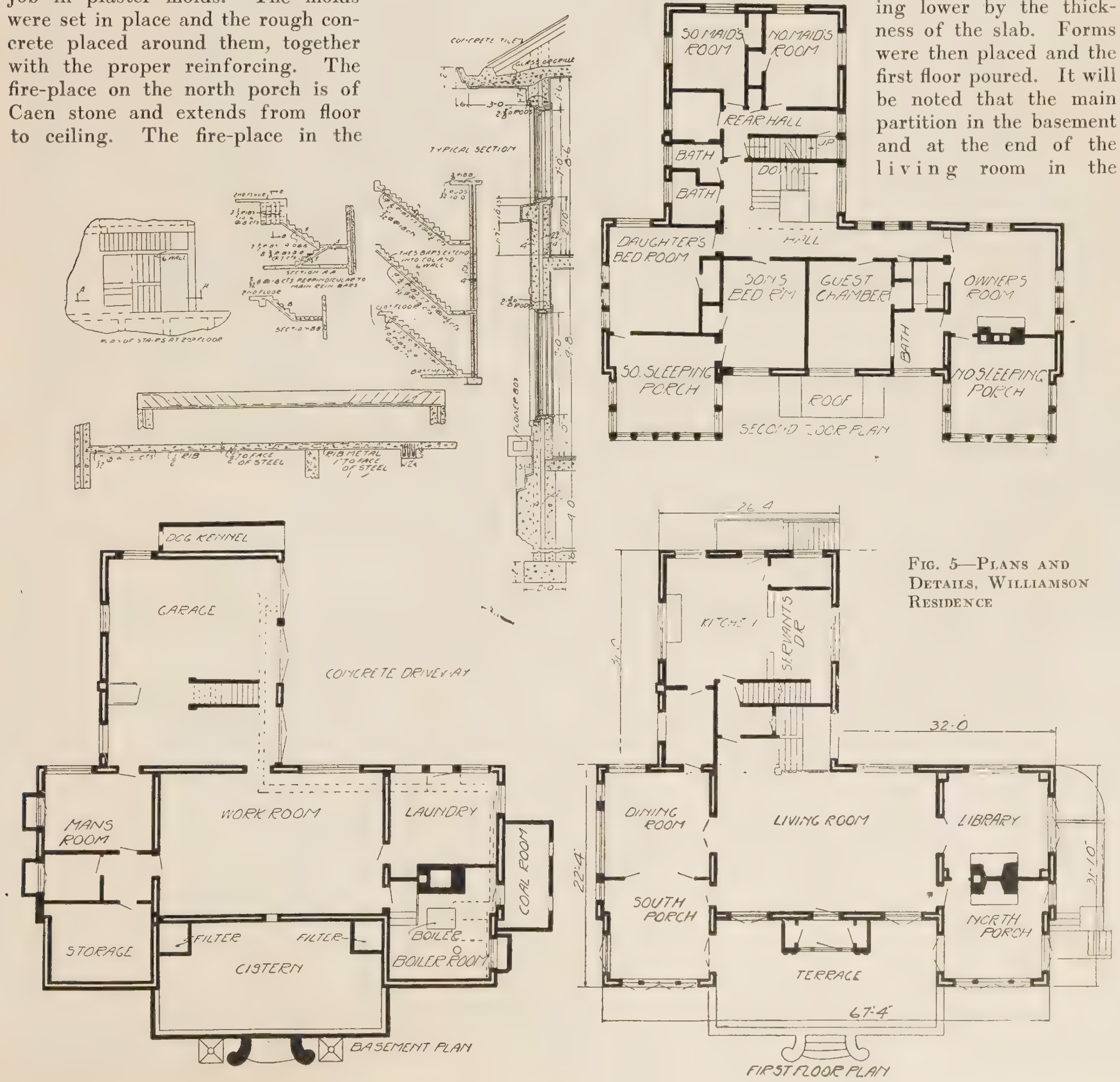

Fig. 5—Plans and Details, Williamson Residence

upper stories are also of double wall construction and support the floors. Other partitions are of metal lath on metal studs, plastered with Portland cement mortar. Above the level of the first floor the wall was reduced to two 4-in. walls and continued at that thickness for the two remaining stories. The second and the third floor slab were poured as the wall reached their levels. The second floor slab is supported on the inside wall and the third floor slab is cantilevered to form the cornice as shown in the section at Fig. 1, with the gutter molded directly in the slab. It will be seen that a suitable abutment for the rafters is also formed on this slab. The frame for the roof is of wood, being practically the only woodwork in the building aside from the trim. The roof is covered with red concrete tile[7] which form not only an attractive but an economical and exceedingly durable fireproof roof.

The long beams which support the floor of the living room and also span the corresponding space on the second and third floors, are of reinforced concrete 12″ x 14″ in section. A detail of this beam is shown in Fig. 2, just above the basement plan. The first and the second floor slab on these beams are 6″ thick, reinforced with No. 8 Ribbed Metal.[8] Other structural floors are of flat slab construction reinforced with ribbed metal and vary in thickness from 4″ to 6½″, according to area.

The concrete was of cement, sand and 1¼-in. crushed stone. It was mixed in a Big-an-Little mixer,[9] with 4½-h. p. engine[10] located in the basement. A wooden charging hopper was filled through one of the basement windows. From the mixer the concrete was handled in wheelbarrows which were elevated on a lift operated by a hoist on the mixer. The lift was located in the stair well of the rear hall, the stairs being omitted until all other concrete was placed and were then built from the top down. Details of the stair construction are shown in Fig. 5.

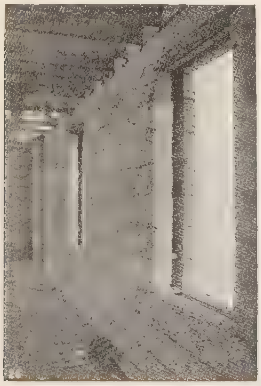

Fig. 6—Detail of Wall

The window frames are removed, to better show construction

COST DATA

As competitive bids were not taken, exact comparative data are not available. It is the owner's belief, however, that the building cost less than it would have, had the wall construction been of stone or of brick. Unit wall costs are given as follows by Geo. E. Lewis[5]: Crushed stone, \$1.50 per cu. yd.; sand, \$2.00 per cu. yd.; cement, \$1.25 per bbl. The machine operators were inexperienced and were broken in on this job. All concrete walls taken together, including the heavy basement walls, cost 19 cts. per sq. ft., including supervision. The 4-in. double wall figured separately cost 15½ cts. per sq. ft. This is exclusive of the stucco finish.

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[7] L. Hansen & Co., Kansas City, Mo.

[8] Trussed Concrete Steel Co., Youngstown, Ohio

[9] Jaeger Mach. Co., Columbus, Ohio

[10] Van Dusan, Roys & Co., Columbus, Ohio

Two Cottages With Solid Concrete Walls, Built Near Middleburg, Va.[1]

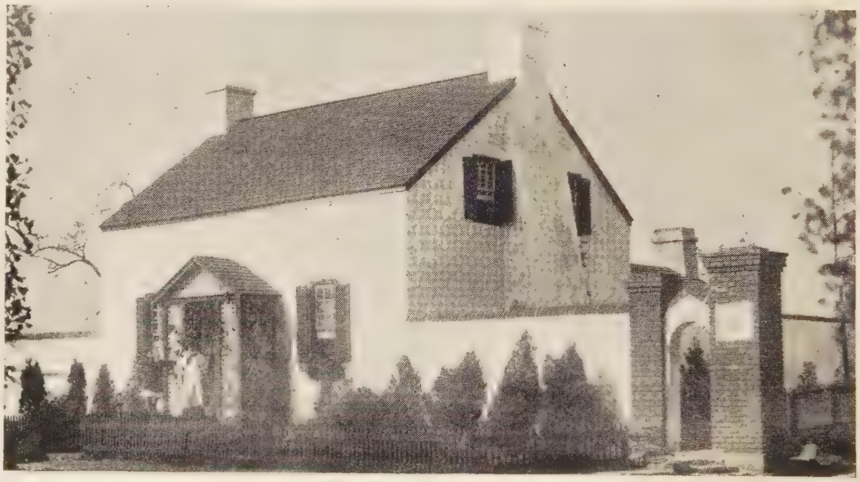

Fig. 1—Cottage with 12-in. Concrete Walls Built for \$2,450. See Plans in Fig. 2

The houses shown in the accompanying illustrations from photographs and floor plans, were built by Claude H. Haga at Huntland, on the estate of Joseph B. Thomas, near Middleburg, Va. They are a part of very extensive concrete work, the stucco surfaces on which are made the subject of a special article.

These houses were referred to briefly in a previous article[2] by Mr. Haga, describing work on the Thomas estate, but the plans are unusually interesting and with them it is possible now to present more detailed data.

The houses are at the entrance of the Thomas estate, one for a lodge and the other for the residence of the gatekeeper. The front walls of both these houses are continued in the walls of the estate. The house with a chimney at either end and with a lattice-screened doorway, was

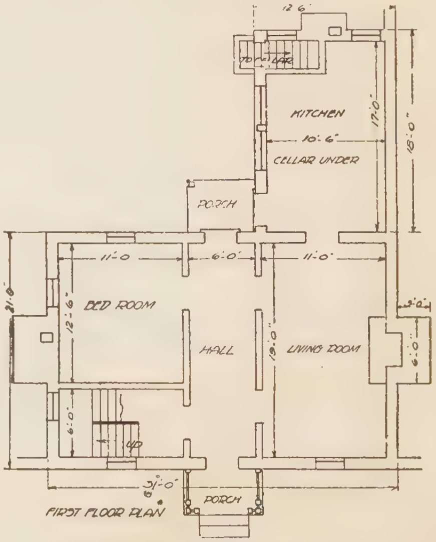

Fig. 2—Plan of Concrete Cottage Near Middleburg, Va.

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[1] From Concrete, Jan., 1915, p. 18

[2] Concrete, Jan., 1914, p. 6

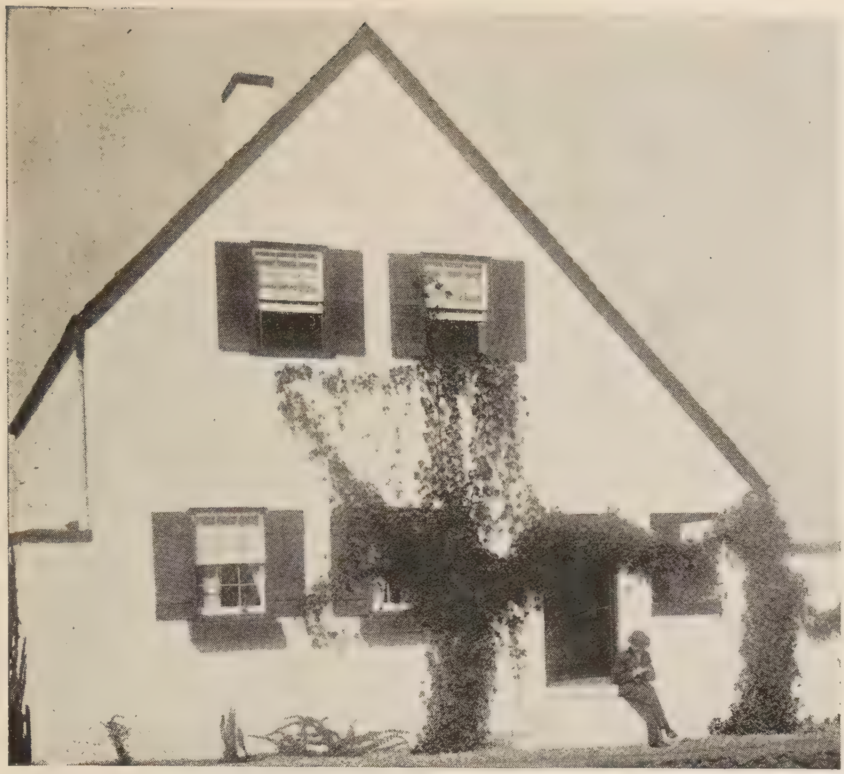

Fig. 3—Concrete Cottage with 8-in. Walls Built at a Cost of $2,700. See Plans in Fig. 4

designed by Mr. Haga, the other by Frederick J. Sterner, N. Y. C.

The house designed by Mr. Haga has 12-in. walls poured in steel forms—the Morrill[3] system, using shallow pan sections 2′ x 2′. The dimensions are shown on the accompanying plans. The first story has a ceiling height of 8′ 6″ and the second story is 4′ to the rafter plate. Walls and chimneys contain approximately 95 cu. yds. of concrete. The mixture used was 1 part cement to 4 parts sand, poured wet and then filled in with field stones—all that the wet mortar would cover as the work progressed. Mr. Haga is of the opinion that 50% of the bulk of the wall is made up of fieldstones. The only reinforcing used consisted of bars placed around openings and in the fireplaces and chimneys. Chimney flues are of terra cotta and the steel forms were used in part in building up the chimneys, the taper being given by a wedge-shaped wood form section, moved upward as the work progressed. The fireplace was made with wood forms on which a steel throat rested. On this throat the flue lining was started. The fireplace was later lined with fire-brick.

Ground floor joists have their bearing on a ledge of the foundation walls, which are 16″ thick, except in the cellar section. The ceiling joists are fastened by joist hangers, held in turn by a 2-in. x 8-in. timber, which is bolted to the walls. Mixing and placing the concrete were done by hand, but in placing the field stones they were dropped into the forms direct from wagons which brought them in, until the wall was above a height of 8′.

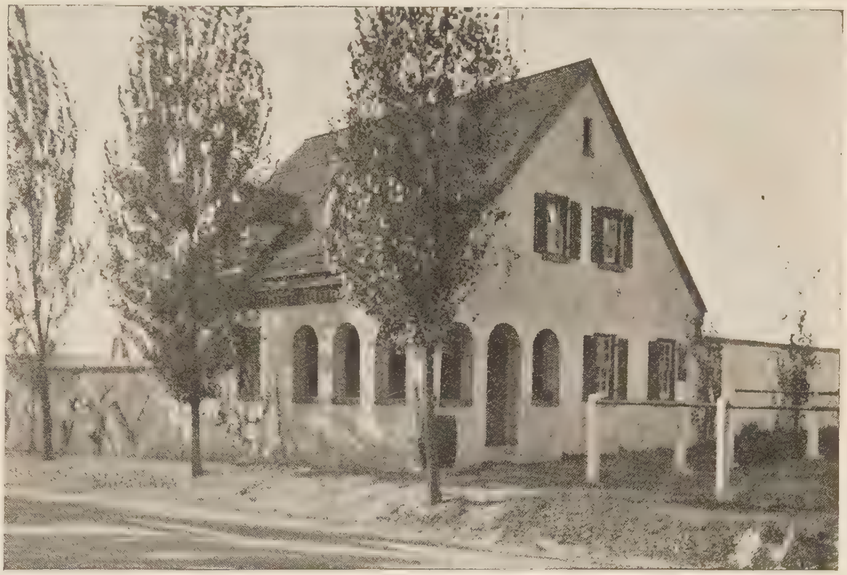

Fig. 5—Cottage at "Huntland," Estate of J. B. Thomas, Near Middleburg, Va.

Mr. Haga figures form setting and removing on this house at $60.

The other house has 8-in. walls of 1:2:4 mix, cement, sand and stone, and because of the thinner walls is much more strongly reinforced. It was also poured in steel forms. Both houses were built at about the same time and in connection with estate walls and various small outbuildings, Mr. Haga figures the cost of the 12-in. wall house at $2,450 and that of the 8-in. wall house at $2,700.

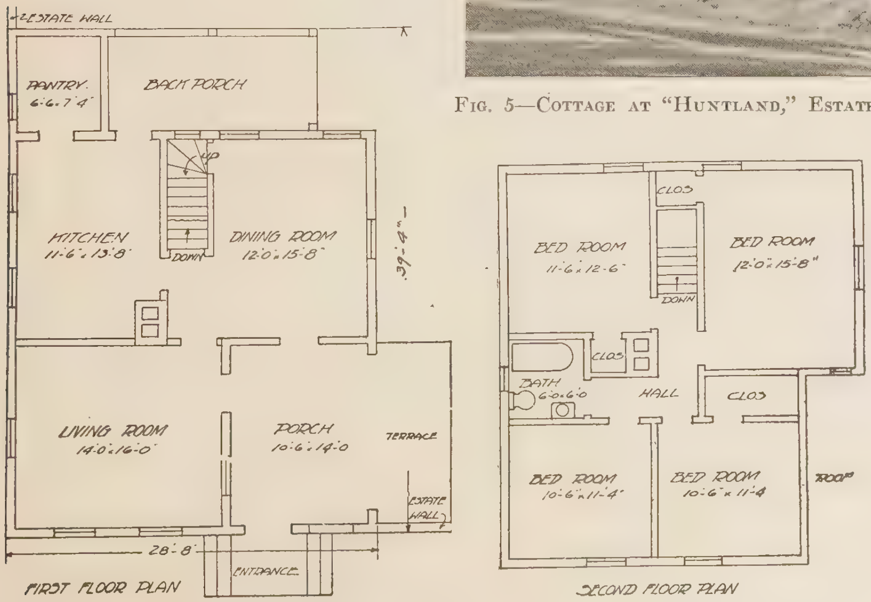

Fig. 4—Plans of $2,700 Cottage with 8-in. Walls Near Middleburg, Va.

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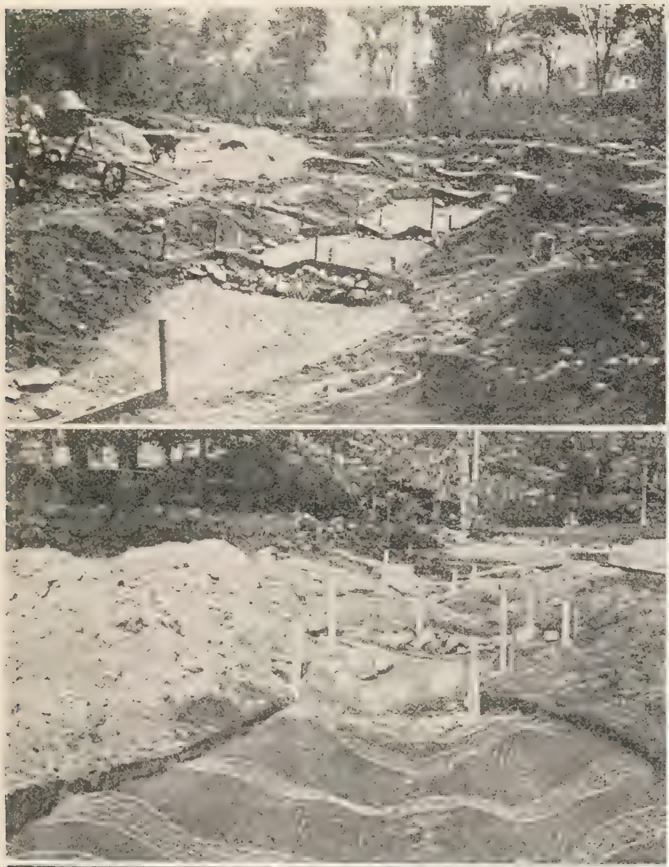
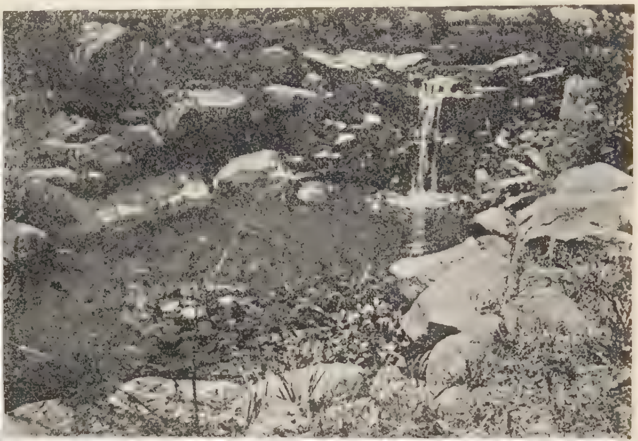
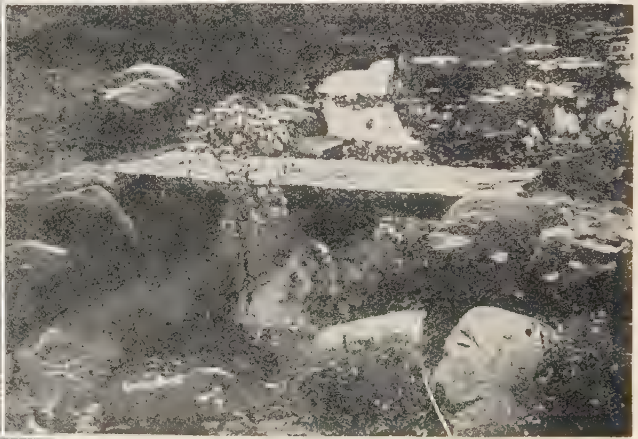
[3] Milton Dana Morrill, Archt., Washington, D. C.

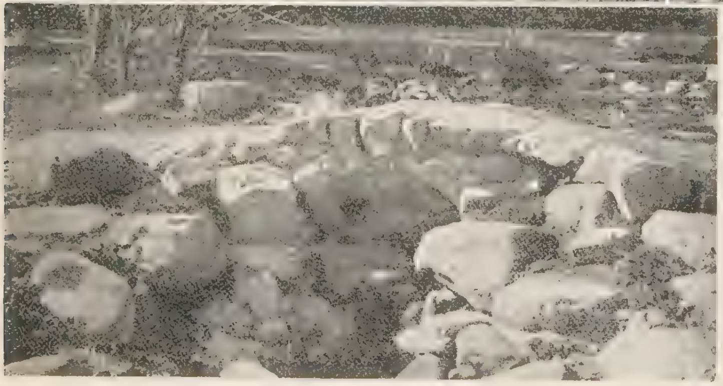
The Use of Concrete in the Construction of a Water Garden

By Ernest F. Coe[1]









Figs. 1 and 2—The Runways Under Construction; at Left

Fig. 3—A Reinforced Concrete Arch Bridge, on a Small Scale

Fig. 4—A Waterfall from One Concrete Runway to Another, With No More Water Than is Supplied by Garden Hose

Fig. 5—A Concrete Flat Slab Bridge:—for Foot Traffic Only

Such effects as we frequently see produced by the beautiful water gardens in parks and other public places are commonly considered out of the question in drawing up one's own home garden plans, yet rock and water gardens are quite possible on a small or a large scale as space permits, with no more water necessary than is used to keep an ordinary city lawn in good condition—providing concrete is used to keep the water from getting away. The rock and water garden shown in the accompanying illustrations is in a space of about 100′ x 150′ only, and this particular work includes half a dozen pools and several runways connecting them. Mr. Coe describes just how the work was done, so that no one need fear to attempt it if he has any ingenuity at all in this direction.

The introduction of water effects in garden-making often adds a most pleasing feature, and the accompanying illustrations show some work which would have been quite impossible without the liberal use of reinforced concrete.

In this special instance it was desired to create a naturalistic, brook-like effect down through a section of the lawn where no water existed, but where the general slopes were such as to make the introduction of a brook effective and consistent. The only available water was the city supply, to be paid for at meter rates. So any undue loss of this precious liquid was to be avoided so far as possible. Any construction which was to be reasonably economical under such circumstances must be sufficiently tight to prevent seepage, yet the soil itself was too loose to retain water.

A plan was adopted to create a series of pools terminating in a pond. There was a drop in grade of about 9′ between the first pool and the end pond. This was taken advantage of in the design, so that aside from the gentle drop of the grade at the runways between the pools it was possible to make quite a little waterfall between the fifth and the sixth pool, which added much to the attractiveness of the general final effect. This is seen in Fig. 4. The main practical problems involved so far as the concrete construction was concerned were first to make the whole system watertight, and this was easily done by using a liberal amount of concrete and, second, to construct the basins so that they would not be injured by winter freezing, for the frosts in this section occasionally penetrate the earth 4′ to 5′. To accomplish this we used heavy wire netting freely between the first and the second courses of concrete as described later. A third problem was to break joints so as to accommodate contraction and expansion due to frost and other causes between pools and runways. This we worked out successfully by first casting the runways between the pools. After these were firmly set, the intervening pools were made. By this method we succeeded in creating a joint at either end of each pool which was calculated to accommodate both contraction and expansion without serious injury to the struc- and as firm as an oyster shell. ture as a whole. Each pool is a unit Further, by making the pools quite shelving, any danger from expansion in the event that they should freeze solid has been overcome as the ice would have a tendency to slip upward and relieve any pressure.

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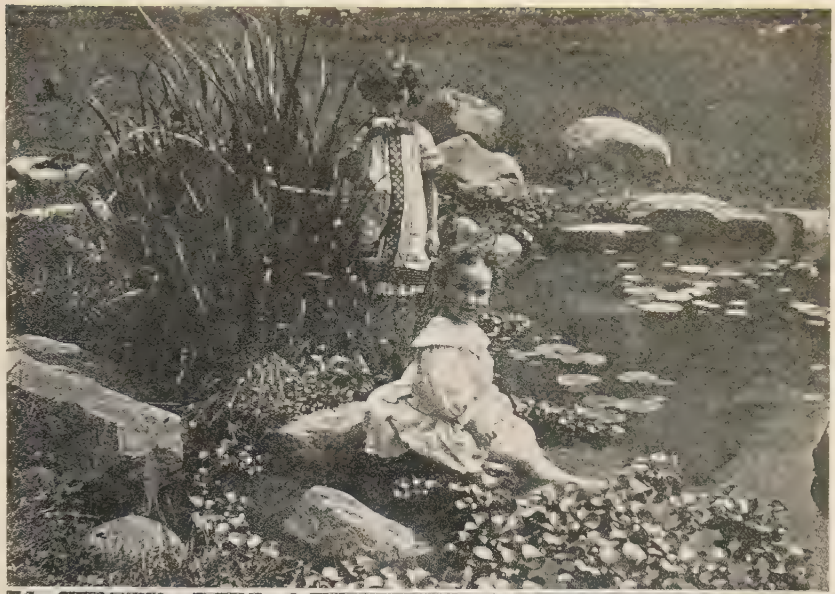
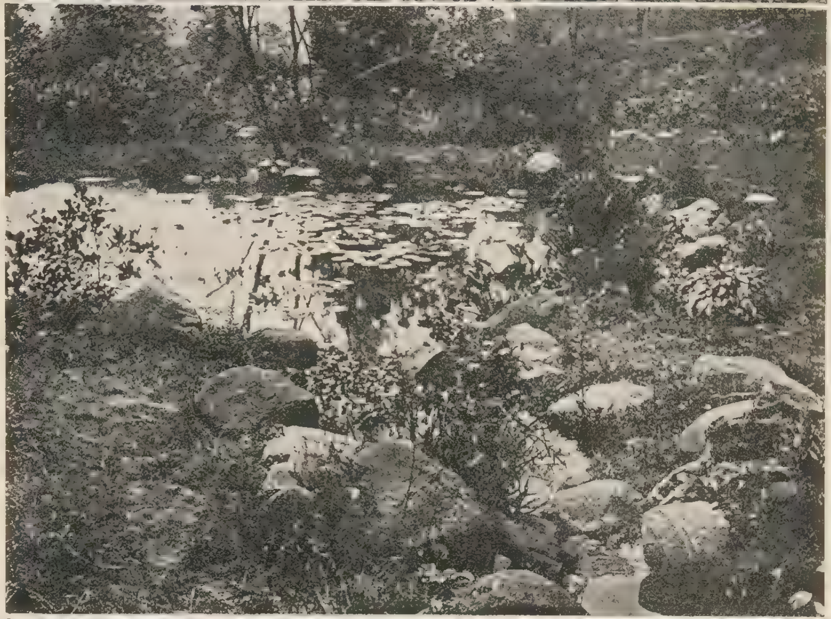
[1] Landscape Archt., New Haven, Conn.

The concrete was made of a good grade of cement and clean sand, and crushed trap rock, proportioned 1:2:3, mixed wet. After thoroughly mixing, the first course was poured about 4″ thick over the earth floor of the excavations. This was firmly but not very thoroughly tamped. A heavy grade of wire poultry netting about 1′ wide was then spread lengthwise and crosswise over each pool and several times around, holding this wire temporarily in place by heavy stones and boulders. Another 4″ to 6″ of a similar mixture of concrete was then placed over the wire and the whole mass firmly and very thoroughly tamped, giving each pool its final shape and with care to maintain grades. Before this second pouring had set thoroughly, a thin grout of 1 part cement to 1 part sand was poured over the surfaces and thoroughly brushed in with a coarse stable broom, the idea being that this surface grout would have a tendency to work its way in and fill up any voids. No waterproofing was employed, though it might have been a good precaution. After the concrete part of this work had been





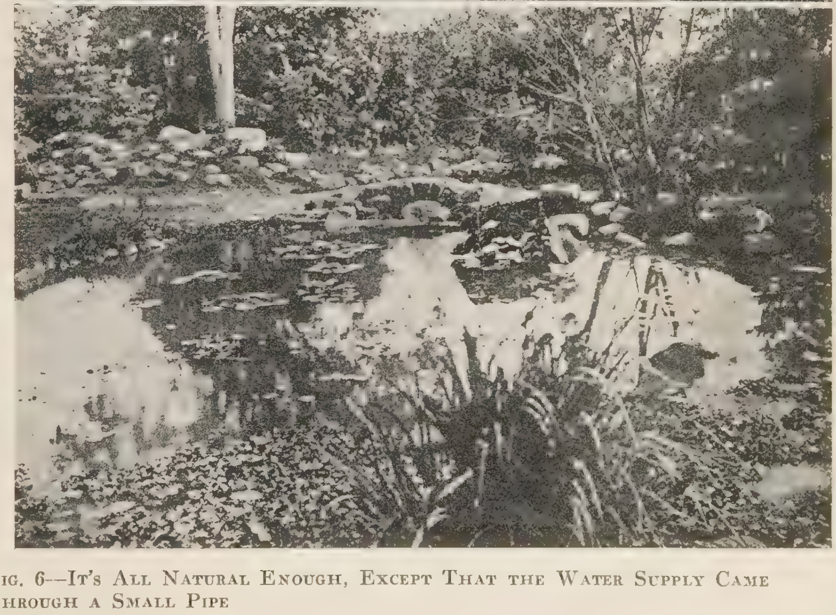


Fig. 6—It's All Natural Enough, Except That the Water Supply Came Through a Small Pipe
Fig. 7—The Last One in the Chain of Artificial Pools
Fig. 8—How Nature Finished Man's Work in Less Than 3 Mos.

completed the general effect was quite unsightly, and it would be hard to imagine how attractive the work would finally appear. The concrete in this instance, however, was used for foundation purposes only, with the intention of quite covering it up when the work was completed. Mossy stones and boulders of various sizes were later placed about the margins of the brooks and pond, filling in with soil and plantings. Water lilies and bog plants were placed in suitable locations. Mosses and other brookside vegetation were brought in from neighboring streams and within the short time of 10 wks. the beautiful effects shown by the accompanying illustrations were created.

Editorial Discussion

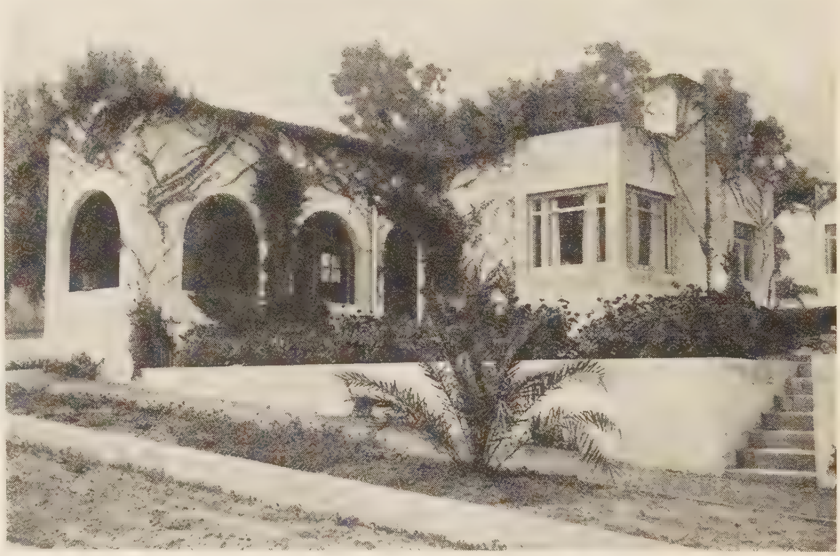
One thing which is quite noticeable in Mr. Coe's work which is here illustrated is the fact that concrete, while a most useful material and in fact essential in this case, is nowhere in evidence.

If the effect is to be as natural as possible, concrete must be kept out of sight. It will be noticed in Fig. 2 that the concrete tips downward at the edges. This was afterwards covered with earth so that there are no edges of concrete to be seen. Another way to make sure that the concrete won't show and yet have the concrete come above the point at the edge of the pool where the water level is wanted, is to make a slight ridge around the inside of the pool so that the top of the ridge which should be, say 3″ high, will be a litle below the water level, or, in the construction, a little below the outer edge of the concrete basin. This ridge will make it possible to extend earth and sod over the edge of the concrete, or to place stones or gravel along the rim without their being so easily washed off.

Mr. Coe does not mention the depth of these pools, but a depth of 2′ in the center is plenty for almost all of the lilies and water plants which one would care to grow, and so far as a limited supply of water is concerned, it should perhaps be added that the water plants generally considered most beautiful will not grow where there is a steady inflow of fresh water. They do best in still water and a proper balance of plant growth and fish life in such pools keeps the water in good condition, and the fish may be depended upon to take care of the mosquito problem. As an aid to the maintenance of pure, sweet water, some oxygenating plants should be used.

Economy and Simplicity in Concrete House Building[1]

By Reed Robinson



The essence of art is simplicity. Only the true artist can afford to be simple, direct and unadorned in his creative work. Art production consists mainly in the elimination of the non-essential.

American architecture is a curious thing, since it is not distinctive as such. Indeed, the phrase "American architecture' is almost an anomaly, since to a considerable extent it is bound to conventionality. Irving J. Gill, San Diego, Cal., is an American architect who has no use for conventionality. His architectural creations are practical art, distinctive and individual. He has boldly and broadly forsaken conventional architecture.

Mr. Gill's specialty is the creation and erection of habitable homes. For a quarter of a century he has devoted his talents to designing and building beautiful homes in sunny southern California. And his work has been pronouncedly individual. It has been artistic and utilitarian.

Mr. Gill has deliberately limited himself to the cube, the hemisphere, the rectangle and to segments of circles in developing a style of architecture which is not only unique, but beautiful and practical as well, in its simplicity. Possibly this is the American architecture looked for as distinctive of the country, yet found generally only in towering skyscrapers.

The plain surface unbroken by cornice or window ledge, the severe arch without column as support and a rectangular skyline, relieved only here and there by the curve of an hemispherical dome, or the graceful and casual figures of a growing vine, are the contours and surfaces used exclusively in the Gill designs.

Another feature which Mr. Gill makes a distinctive point in his work on residences, is the effect of reflected colors upon a white or a neutrally tinted, unbroken surface. To the discerning observer of color the plain white surface is composed of delicate and changing hues which takes tones from the greens of the lawn or tree, the blue of the sky and the multiple shades of the varied flowers. The splashing warmth of crimson from a geranium bed, together with the varied lighting of morning or afternoon, clear or cloudy weather, produce effects upon these walls that are a delight to the eye.

This idea of reflected colors is employed by Mr. Gill not only in connection with the outside walls but in planning the lighting of interior rooms. The walls are designed with surfaces as flat and unbroken as possible. They are finished in a plaster surface slightly roughened. The ceiling is tinted a light neutral shade. The side walls are tinted likewise though the color is a shade deeper than that of the ceiling. The result of this treatment is such that ceiling and walls take on the hue of the dominant color note in the furnishings. This makes the rooms especially delightful to the eye and extremely restful for the occupant in the matter of light and color. This idea is characteristic of every Gill house.

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[1] Abstract from Concrete, p. 55, Apr., 1914

From the standpoint of the owner it is eminently satisfactory to note that a Gill house is much cheaper than that of most others. The comparatively low cost of the Gill houses is largely due to the fact that concrete is the only material used and Mr. Gill's ideas of simplicity of line in architecture make the very most out of the material concrete. It is such use of concrete which is most economical and which is most characteristic of the material. Wood is employed but sparingly, and this for interior finishing of doors, windows, stairways, etc. Mr. Gill, by the use of concrete, has been able to produce handsome and distinctive residences. By the use of concrete Gill structures are built at a cost lower than corresponding construction could be done with wood or other material.

In a general way Mr. Gill figures concrete in house construction at approximately 30 cts. per cu. ft. in place. He figures the walls at 10% of the building cost.

In a typical Gill house wood forms were used for the entire construction—walls, floors, stairs and roof. The first floor and garden walls are 12″ thick and second story walls 8″ thick. Finished floors are 8″ thick, with ¾-in. twisted rods for reinforcing 1½″ from bottom of slabs. The concrete stair slab is 4″ thick in net section and reinforced with ¾-in. twisted rods laid full length of the stairs at the sides of the stair. The roof is a 6-in. slab reinforced with Hy-Rib.[2] The walls are reinforced with Elwood wire fencing, 4-in. triangular mesh, placed 1½″ from outer surface. In general a 1:3:5 mix of cement, sand and gravel was used. It is Mr. Gill's policy, however, to change the mix from time to time, depending upon tests of sample concrete from the materials available. Concrete was conveyed in wheelbarrows.

After the removal of the forms the outer wall surface was smooth stuccoed with a heavy coat of a mixture of 1 part cement to 1 part sand with a 5% admixture of hydrated lime.

A special feature is that interior woodwork is finished flush with the walls in every part of the house. All doors, whether leading from room to room or into cupboards and closets, are built without panels and set flush with the casings, which, in turn, are flush with the walls. This feature makes a practically dustproof house and eliminates a distressing item of housework. Not only that, it makes the rooms more sanitary.

Drainboards and backs of sinks are of magnesite. The magnesite slabs are finished flush with the walls. Corners where they meet the sink are rounded, eliminating cracks in which grease or dirt may collect and doing away with exposed wood to become sour and decay from constant wetting. Bathtubs are boxed, then covered with magnesite up to the porcelain tub edge and finished with rounded corners. Bathroom floors are of magnesite with all angles rounded. This construction in the bathroom renders it easy to keep clean and wholesome. In fact, there are no cracks, corners or crevices, projections or sharp edges in the entire structure.

The use of concrete in carrying out these ideas in house construction makes them practical because concrete as a building material is inexpensive, adaptable, reliable and lasting. Through the use of concrete Mr. Gill attains these effects at a saving of time, cost and labor and with the certainty of satisfactory results.

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[2] Trussed Concrete Steel Co., Detroit

Using Hand Power Hoisting Rigs for Small Work[1]

By C. D. Gilbert

Construction jobs divide into three types. First, the large building where power for the hoisting is available; second, the small job where power is available, but where it would not pay to set up as elaborate a rig for hoisting as on the larger jobs owing to the small amount of material handled; third, jobs large and small where concrete must be hoisted by hand.

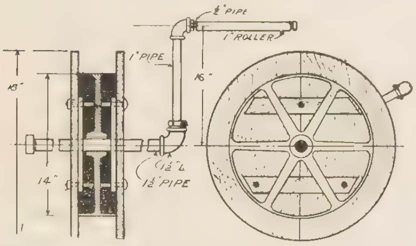

Fig. 1—A Field-Rigged Drum for a Hand Hoist

On the jobs of the first class a regular elevator may be installed as is done for any large job of concrete construction work. The elevator can on most house jobs be operated by a drum on the mixer.

On some jobs cable with trolley can be substituted. The pulleys should be about 10″ in dia. in order to have the hoist work nicely. This is essentially an inclined trolley or cableway hoist, and under many circumstances should prove very economical. (See Fig. 4, Page 19.)

A HOME-MADE DRUM

In a great many cases, however, hoisting machinery is not available or the job is so small that it would not pay to install either of the foregoing methods. The details of an inexpensive rig which was recently used on a comparatively large building, and with which one man hoisted without difficulty as much as 10 cu. yds. of concrete per da., will be found useful by many builders. The materials for this can be found on any farm or around any factory or junk heap, and the work of making it will require but a short time.

Secure a pulley from 12″ to 16″ in dia. (14″ is best) and mount it on a piece of pipe for an arbor. The 1½-in. pipe approximately fits a 2-in. hole in the pulley. The pipe should be threaded on both ends, and a crank built of pipe and fittings as shown in the drawing, Fig. 2. Make two flanges of wood about 6″ larger in dia. than the pulley used. Cleat them so that the cleats will come inside the rim of the pulley. Bolt on to each side of the pulley as shown. If there is danger of the pulley turning on the pipe it is well to drill a hole through the pipe and put a pin through it, fastening it securely to the wood flange. This drum should be mounted on two pieces of plank leaning against the building shown in Fig. 3. The bearings require no cutting of the plank and are most easily made by nailing pieces of 2-in. block above and below the arbor with a cleat on top. The simplicity of this device allows several places to be used around the large building for hoisting by simply carrying the drum from one place to the other as the machine works around the building, and often lessens the distance which the concrete must be carried on the staging.

The pulley at the top should be large and run easily for the best results. This is an especially good rig for house and silo work.

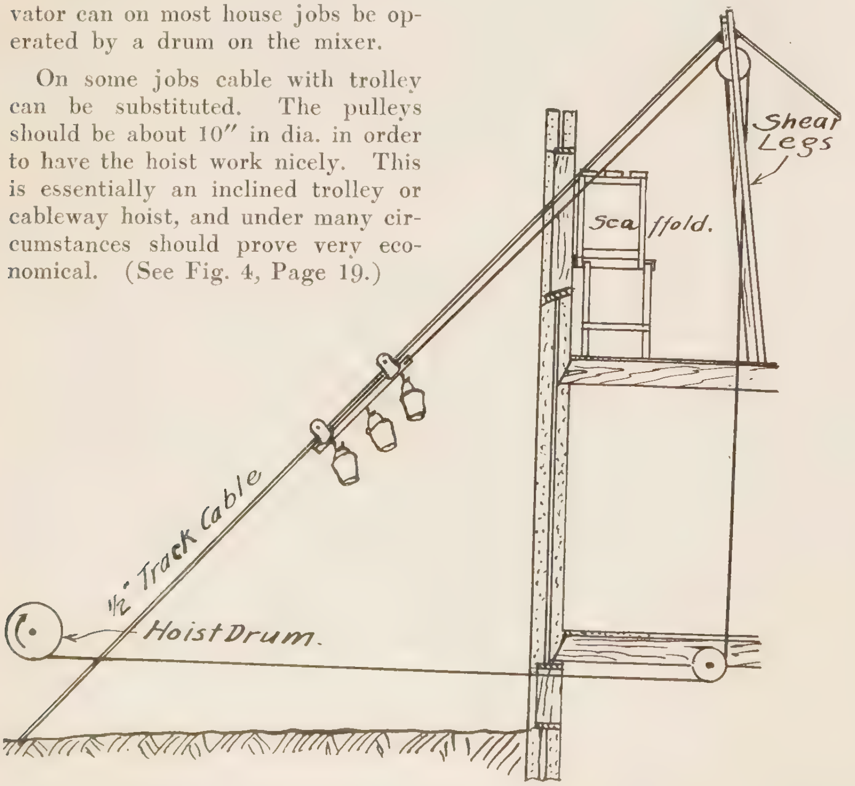

Fig. 2 Sketch Showing Arrangement of An Inclined Cableway for Handling Pails of Concrete

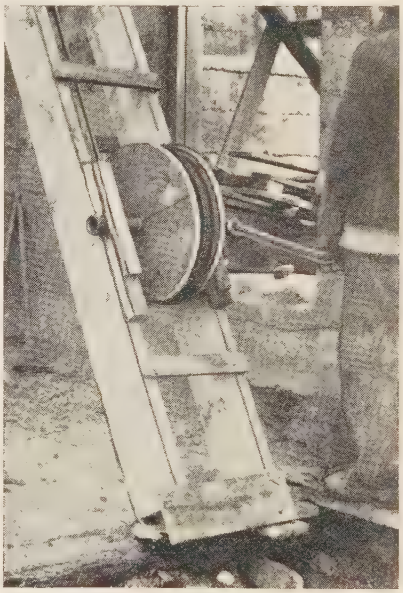

Fig. 3—Using a Hand Hoist and Pails to Raise Concrete

Many manufacturers of concrete building units — block, dimension stone, brick, etc.—will do well to rid themselves of the idea that their materials are not specified for good work because of prejudice. Sound, *good-looking* units are in demand. Be prepared to let the man who uses the material decide as to whether or not it is good looking.

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[1] From Concrete, Apr., 1914

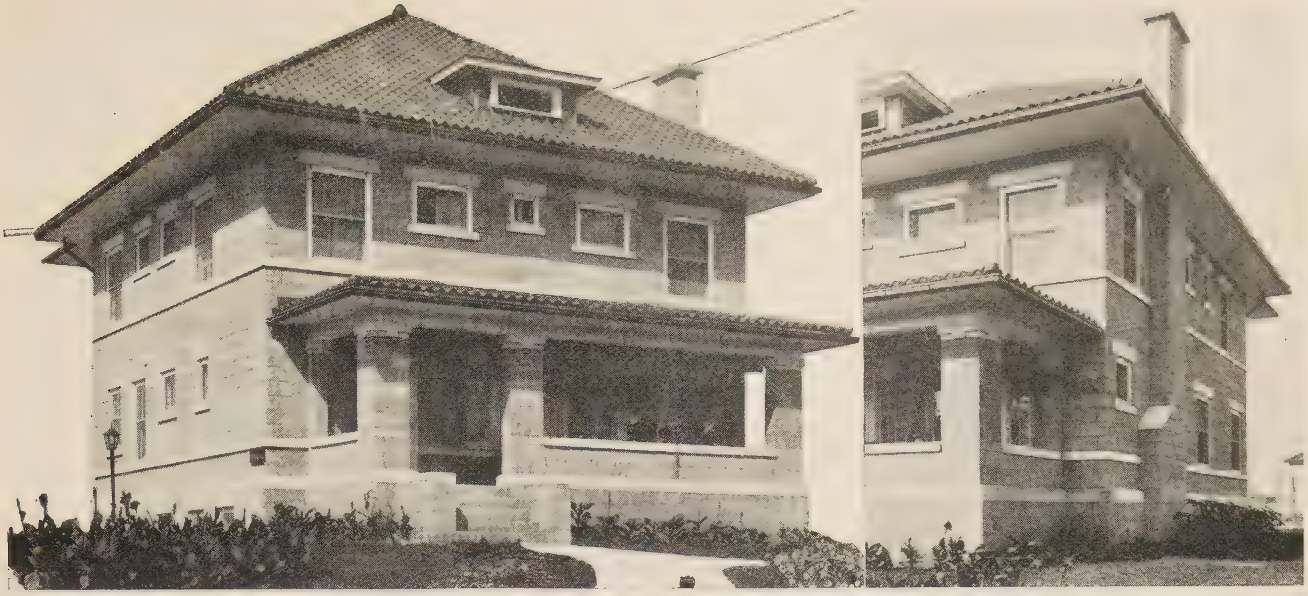

FIG. 1—TWO VIEWS OF RESIDENCE AT MOOSEHEART, ILL., BUILT OF FACED CONCRETE BLOCK AT A SAVING OVER FACE CLAY BRICK OF 19.7%

Concrete Block Used in Attractive and Economical House Construction at Mooseheart, Ill[1].

The accompanying floor plans and illustrations from photographs show the residence and office of the dean at Mooseheart, Ill., being one of the many buildings with walls of concrete block which are being constructed in a large group by the Loyal Order of Moose, as a philanthropic and educational institution.

The manufacture of these block and their use in construction work, with detailed costs, have been described in previous articles[2] by R. F. Havlik, who is in charge of the work.

Mr. Havlik supplies the present data and plans.

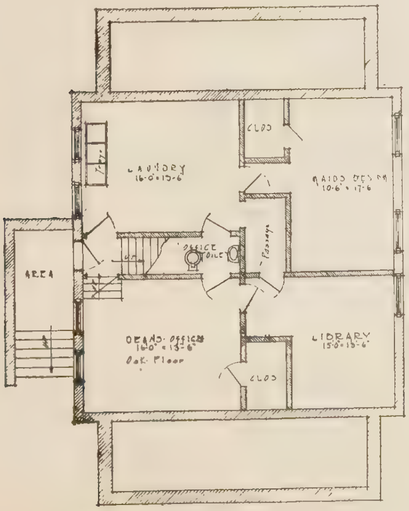

FIG. 2—BASEMENT PLAN

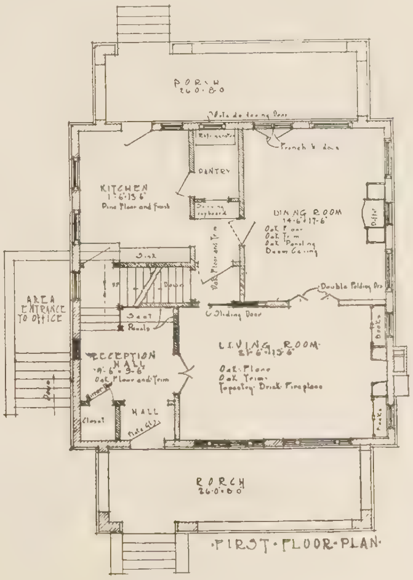

FIG. 3—FIRST FLOOR

The building is 33′ x 33′ in plan with two stories and a basement, but in reality it is a three-story building without a basement. The entire interior of the building is plastered so that it consists of 12 finished rooms and a large bath room. There is a sleeping porch approximately 8′ x 28′ a large front porch of the same size, three sets of concrete steps leading to the rear and the front porch and to the Dean's office in the basement. The area-way leading to the office is faced with concrete on both the inside and the outside. The maid's room, the library and the office are trimmed with yellow pine and finished in natural color. The maid's room and the office are both floored with the best grade of clear oak, 7/8″ thick. All of the basement rooms are plastered with two coats of plaster, sand-finished. The inside stairway leading to the first floor is of oak. The reception room, living room and dining room are trimmed in oak, and the wood work is finished in old English. The walls of the dining room are paneled in oak. The kitchen is trimmed with yellow pine. The refrigerator is so placed that it can be filled from the outside.

All the porch floors are of concrete but the inside floors are of wood construction.

All the floors of the first floor, with the exception of that in the kitchen, are of clear oak, 7/8″ thick. There is a large fire-place in the living room and elaborate bookcases are built in on both sides of the fireplace. The dining room has a finely finished oak buffet built especially to fit the room. French windows open from the dining room onto the rear porch.

The second floor contains four large chambers and a large bathroom. Each room is supplied with a large comfortable closet. The two rear bedrooms open directly on the sleeping porch. All of these rooms are trimmed with clear birch and stained a mahogany color, wax-finished. In building this house it was felt that it would be more or less of a public building, because the Dean would be required continually to entertain a large number of visitors, so it was considered advisable to build as pretty and comfortable a home as possible. Therefore no expense was spared in this building to attain this end. For this reason total costs are of little consequence in a consideration of the economy of concrete.

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[1] From CONCRETE, Jan., 1915, p. 15

[2] CONCRETE, July, 1914, p. 16; Aug., 1914, p. 55

The roof of the sleeping porch is covered with 16-oz. copper. The front porch and the roof of the main building are covered with Spanish red tile. Future residences of Mooseheart will not be so elaborate internally as this one, as a residence of this size is far too large for the ordinary family, but this is an excellent example of the character of work that can be done with the Mooseheart concrete block and trim stone. In general this building represents the type of building that will be put up at Mooseheart for residential purposes. All of the block used in this building were made by the Hydro-Stone[3] process, faced with Mica Spar Crystals.[4] Universal Portland cement[5] is used for all the granite block and for the backing of the trim stone. Some of the trim stone used at Mooseheart has been faced with Medusa white cement[6] and some has been faced with Atlas white cement,[7] both of which have proven satisfactory.

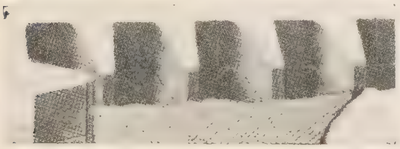
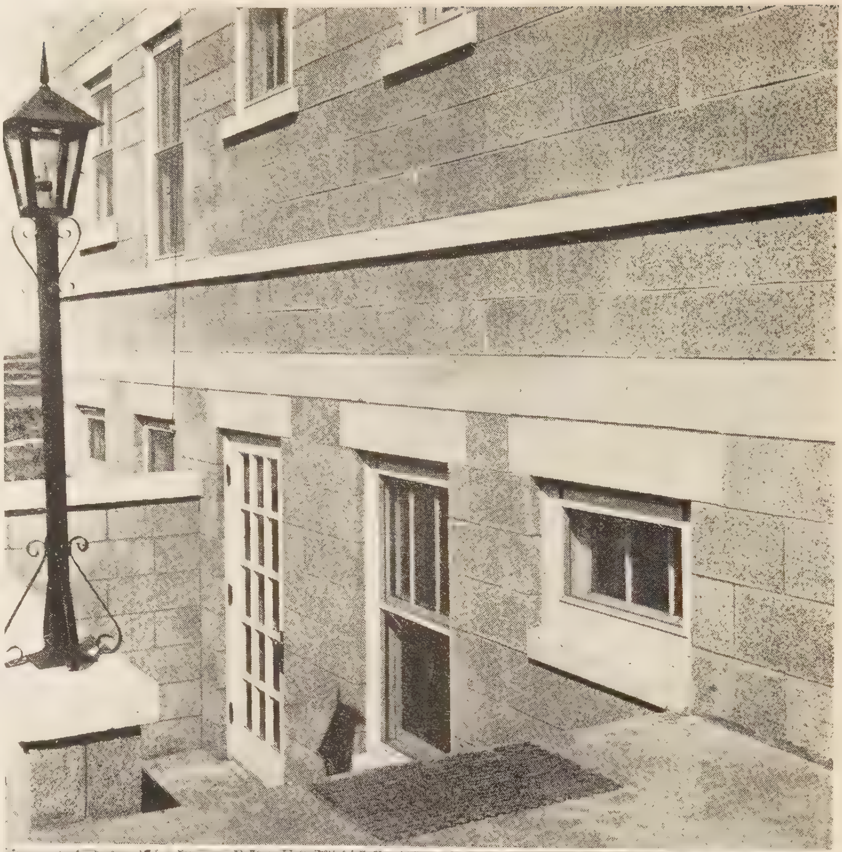


Fig. 5—Wall Construction with Two-Lug Block



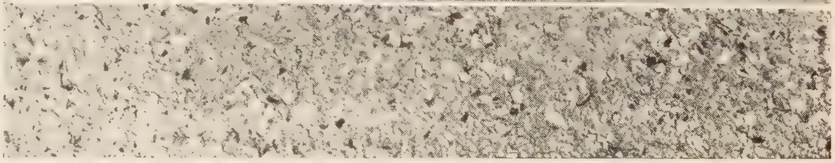


Fig. 6—Detail of Basement Entrance

Fig. 7—Detail of Faced Block Surface

From Mr. Havlik's previous accounts of concrete block construction the costs of the wall construction are taken.

The block used in the Dean's home are of the two-lug type, giving a wall with a minimum thickness of about 2½″ and two projecting lugs on which furring strips are attached vertically by means of wall plugs or wire loops, held in the joints. The interior lath and plaster are then applied on the furring, giving a light yet stable and well insulated wall. All block used above ground on this house are faced, and washed and scrubbed while green to expose and brighten the facing aggregate.

The cost of material for block of this kind, using a 1:5 backing and a 1:2½ facing (face area of block 9″ x 24″; thickness, including lugs, 8″) has been 9 cts.; the cost of labor in manufacture, including delivery, 7 cts., and overhead at 20%, 1.8 cts. This gives a total cost of 17.8 cts. per block, each block filling an area of 1½ sq. ft. in wall surface. On this basis 100 block giving a wall area of 150 sq. ft., cost $17.80, allowing for no manufacturing profit. Or allowing a manufacturing profit of 25% the cost of material for 150 sq. ft. of wall becomes $22.25. The cost of laying has been 11 cts. per block, or on 100 block $11, giving a total cost for 150 sq. ft. of wall of $33.25.

The cost of 150 sq. ft. of 8-in. brick wall, the thinnest brick wall generally permissible, would include these items: 900 brick laid at $16.00 per M, $14.40; 900 face brick laid at $30 per M, $27; a total of $41.40. The saving in using the granite block is thus $8.15, or 19.6% on the cost of brick.

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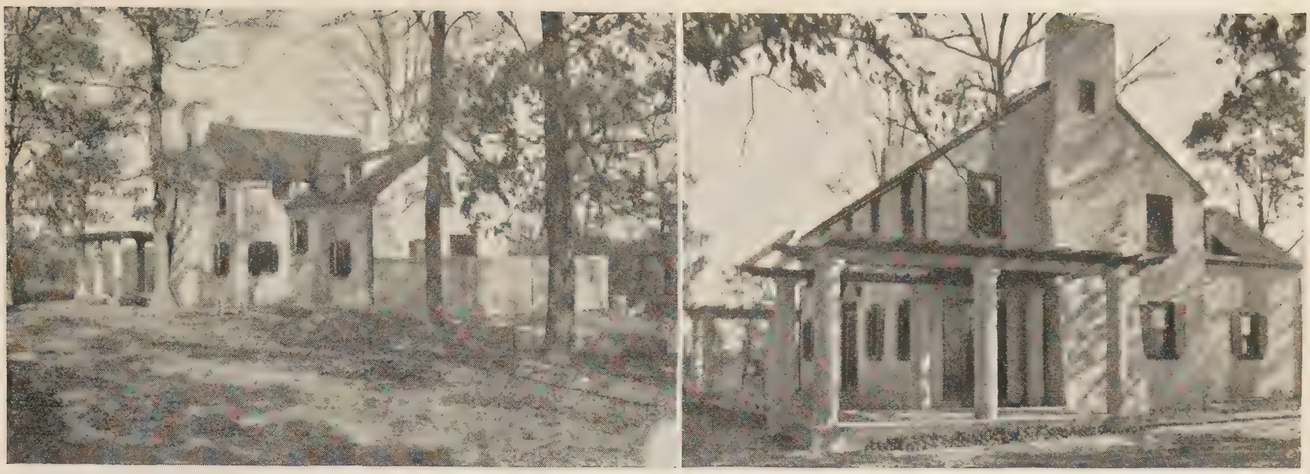
[3] Barron & Harridge, Chicago

[4] Crown Point Spar Co., N. Y. C.

[5] Universal Portland Cement Co., Chicago

[6] Sandusky Portland Cement Co., Sandusky, Ohio

[7] Atlas Portland Cement Co., N. Y. C.



FIGS. 1 AND 2—TWO VIEWS OF HOUSE OF MR. MASSEY AT MIDDLEBURG, VA.

Two Houses of Poured Concrete Erected at Middleburg, Va.[1]

The accompanying plans and illustrations of houses at Middleburg, Va., with data as to construction, are presented through the courtesy of Milton Dana Morrill. The construction is similar to the work on the Thomas estate, described in another article.

Plans and illustrations from photographs shown here are of residences for G. Gordon Massey and for E. W. Murphy. The poured concrete walls of these houses have a thin stucco finish. The floor and the roof construction in both cases is of frame.

The house for Mr. Massey was designed by Milton Dana Morrill and built by Claude H. Haga, contractor. The foundation walls are of concrete with field stones bedded in the mix, the thickness of the walls being 12″. The walls above the second floor level are 8″ thick. The reinforcement is horizontal only, with but from 2 rods to 4 rods of $\frac{3}{8}$-in. size put in over openings in the wall. The concrete used was a 1:2:4 mix, the stone used being obtained from field stones crushed on the job. The walls are furred for lath and plaster and in order to have nailing places for the furring small wood nailing block were dropped in each day as the work progressed. Each of these block had a nail driven into it part way and the block were dropped in 16″ o. c. with the nail projecting down into the freshly placed concrete to hold them in position next to the inner form. The exterior walls were covered with a thin coat of stucco mixed with Atlas white cement[2] and sand in equal proportions. The porch is set in concrete tile. The entire house cost approximately $7,000.

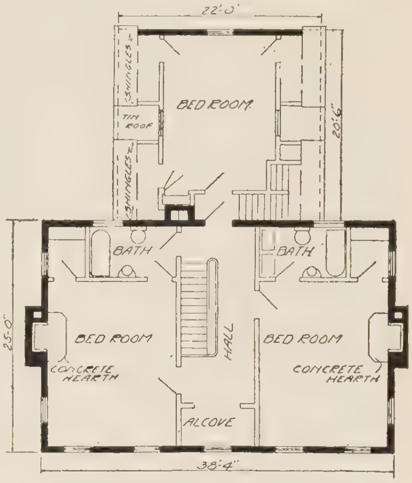


FIG. 4—SECOND FLOOR PLAN, MASSEY HOUSE

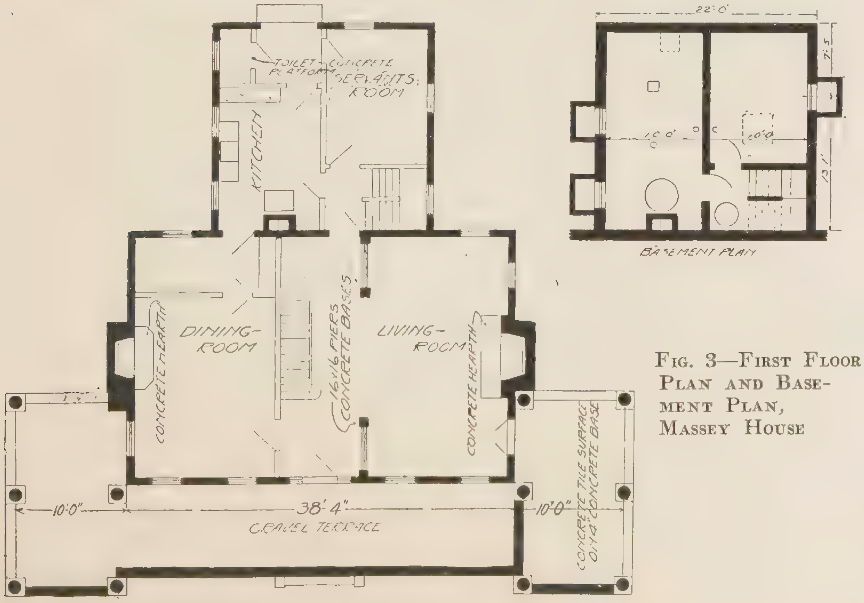


FIG. 3—FIRST FLOOR PLAN AND BASEMENT PLAN, MASSEY HOUSE

The house for Mr. Murphy was designed by Claude H. Haga and the work was finished under the direction of Mr. Morrill after Mr. Haga's death. The walls, as in the case of the Massey house, are 12″ thick. Here the partitions are 8″ thick. The only reinforcing is $\frac{1}{2}$-in. rods placed over windows and doors, horizontally. Reinforced slabs were used over the porches at each end of the house. Elsewhere the usual wood joist construction was used in the floors. This house was given a stucco finish, thin like that on the Massey job, but after this had been put on it was washed down with white cement and water which was tinted with ochre to give the walls a mellow tint. There was an old stone house on the Murphy house site and the old stone was crushed and used in the new building. Field stones were also utilized in making the concrete. Interior walls were furred for lath and plaster and pipes were placed in spaces formed by the furring. All radiators are concealed in recesses under the windows, this being possible owing to the very thick walls. A construction of this kind, while not ordinarily economical in such great wall thickness, was felt by both Mr. Morrill and Mr. Haga to be so in this case, due to the experience which they had had in building houses on the Thomas estate. It was found that with thick walls, where it was possible to bed a large amount of field stone in the concrete, it was just as cheap as thin walls which had to be heavily reinforced.

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[1] From CONCRETE, Jan., 1916, p. 22

[2] Atlas Portland Cement Co., N. Y. C.

On both of these jobs the forms were handled in such a way as to use two tiers of forms, or a total form height of 4′, and pour one tier a day. The lower forms were taken off each morning and swung up on a frame so that they were handled together in long strips and in the new position were filled again. Thus the two tiers alternated every two days. The concrete was handled in wheelbarrows to 4′ above grade. Above this height pails were used as far as the second floor level, the pails being handled in wheelbarrows four at a time and taken to different parts of the building and passed up to the tops of the forms by hand. Above the second floor level the pails were hooked to a grapple four at a time and raised to the form level by a drum on the mixer. They were then carried by hand. No staging was necessary, as the floors followed the walls, nor was any staging or outside scaffold used in handling the forms. The average labor cost for cleaning and fitting the steel forms was 1 ct. per sq. ft. of form surface or 2 cts. per sq. ft. of wall. In both cases the exterior stucco finish was put on about 60 das. after the walls were up. The stucco is very thin, in some places not more than ⅛″ thick. The illustration of this stucco surface, shown on another page, indicates slight crazing, but this view is from a photograph taken at very close range and, owing to the rough texture, the crazing is not objectionable, in appearance, at least, and it is believed that the walls are so nearly waterproof in themselves as not to need the stucco as a seal coat. Stucco put on in this same way more than 3 yrs. ago shows no signs of peeling. It is only with very true forms and smooth cast surfaces that it is possible to use so thin a stucco to smooth up a wall.

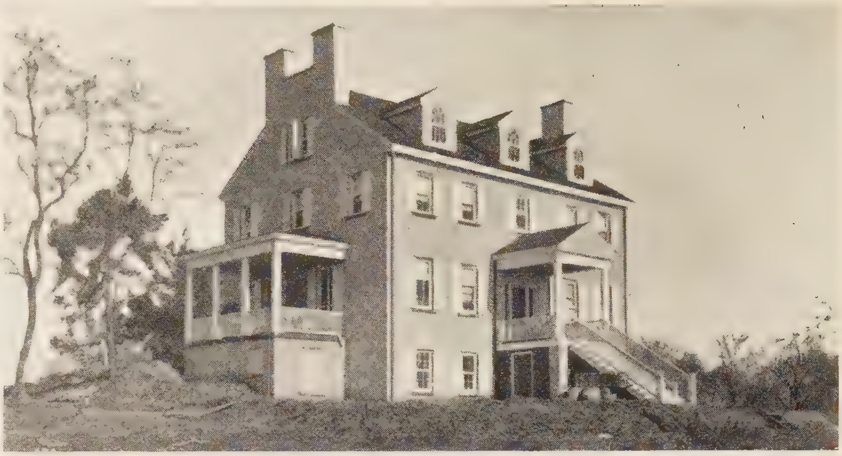

Fig. 5—Home of E. W. Murphy at Middleburg, Va.

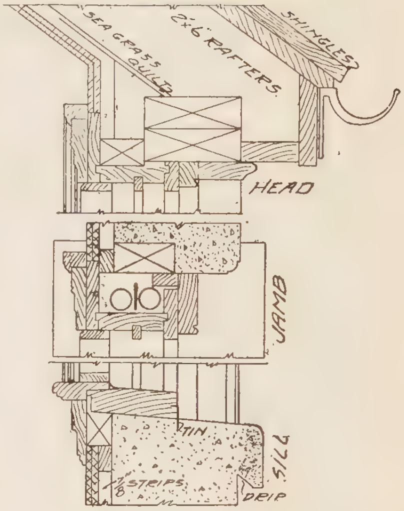

Fig. 8—Details Window Frames and Cornice, Massey House

Fig. 7—Rear View of Wall Cottage at Huntland, Estate of J. B. Thomas, Middleburg, Va.

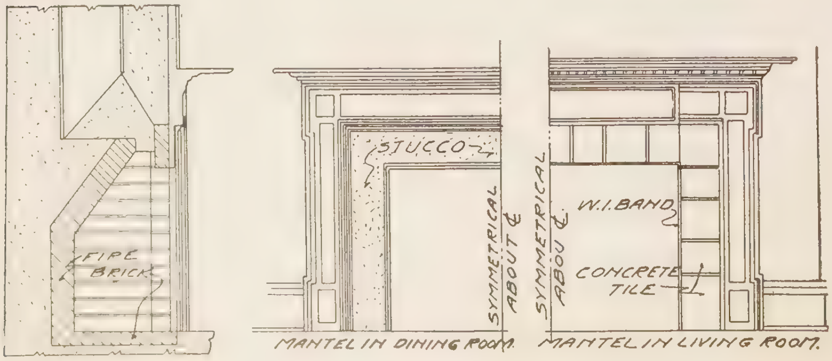

Fig. 6—Fireplace Details, Massey House

One Owners Way of Treating Concrete Floors

A correspondent writes:

We have tried out several materials for waterproofing and wearproofing our floors and have found from actual tests that the best we could use was boiled linseed oil thinned with about 20% benzine when applied, to draw the oil into the floor. We have used this on our buildings and it has worked very well. It has obliterated all the dust, and has formed a solid covering on top of the floor, which we think will last us a number of years before it will need any renewing.

As the oil and the benzine are very reasonable in price, we think the mixture would be a good thing to use wherever something is required for dust-proofing concrete floors.

The Construction of Small Concrete Houses at San Juan, P. R.[1]

By Earl K. Burton[2]

The accompanying illustrations suggest the beauty of concrete home architecture in competent hands. The Spanish architect has long been accustomed to the use of stucco and tile, and he apparently finds easy a task that has too often been bungled.

The construction methods illustrated are simple and the costs, in view of the prices paid for material and labor, and the results obtained, are not high.

It is well to note that while the single wall construction described would no doubt be satisfactory in a genial climate like that of Porto Rico, in the north a double wall would be required, built either of structural concrete or secured by means of furring and lath.

Since the inauguration of reinforced concrete residences of the bungalow type in Porto Rico some 5 yrs. ago, they have gained much favor among Porto Ricans and American residents of the island. This type, which is exemplified in the accompanying illustrations, is the standard of construction in the residential district of San Juan known as "El Condado."

This modern reinforced concrete dwelling is in marked contrast to the type of Porto Rican residence formerly built and still in use to a large extent. The old structures usually consisted of very heavy brick walls ranging in thickness from 18″ to 24″ and plastered both inside and outside with a mortar of pulverized brick and natural cement. Occasionally one would find the interior partitions of the same thickness as the outside walls, although they supported only the roof. This type depended for durability and strength upon its massiveness only. The arrangement of the interior was very simple, usually rectangular in shape with one hall or passageway extending the entire length of the building and with rooms located symmetrically on either side of the hall.

The modern dwelling, the construction of which is here described, is architecturally similar to the American bungalow. Its outside appearance would seem identical with bungalows in California and other parts of the U. S., and essentially it is, but several features are included that make it distinctive, both from necessity and from local artistic temperament. For example, shutters are installed in nearly all window openings. They permit practically 100% ventilation and at the same time diffuse the intensely bright sunlight. Also, the Porto Rican is a lover of tile floors and of colors that give contrast. Tile floors will be found in some parts, if not all, of the house, and faience tile panels are inserted in the outside walls. The living room and the dining room are generally thrown into one large room, there being either a wide arch or columns and grill separating them. These are customs that have prevailed in Porto Rican homes for years.

STRUTURAL FEATURES

The footings and the outside walls are constructed of reinforced concrete, the latter extending to the full height of the building. The footing usually consists of a solid course of concrete 9″ to 1′ in thickness and 2′ 6″ to 3′ 6″ in width. In some cases footings have been placed in filled ground below sea level and very close to the shore, in soft sand. This has necessitated the construction of a spread footing of unusual width and depth, heavily reinforced. Such a footing acts in the same manner as the so-called "raft" foundation. A footing wall 10″ thick extends from the footing to the floor line and is offset here to form a belt course around the building on the outside and a bearing for the floor joists on the inside. For one-story structures the wall above the floor has been constructed of reinforced concrete 4″ thick or of metal lath and plaster on studs. In the latter, the wall is 6″ thick. The footing and footing wall concrete is mixed in the proportions of 1:3:6, using American brands of Portland cement, river sand, if possible, but usually sea sand, and broken stone (a blue trap-rock of excellent quality), ranging in size from ½″ to 1″. The footing and footing wall are poured monolithic around the entire building and the former is reinforced with from three to five ¾-in. bars longitudinally and ½-in. bars transversely, spaced 24″ o. c. The footing wall is reinforced with ½-in. bars spaced 12″ horizontally and 24″ vertically. The 4-in. concrete wall has the same reinforcement as the footing wall. Four inches may appear thin for a wall supporting a roof and it would seem that it would be hard to pour so as to obtain a smooth surface and to eliminate the "honeycombs." The latter objection is overcome by the use of a mixture of Portland cement and screenings mixed 1:5. The screenings are the hard trap-rock mentioned above and range in size from ¼″ to the smallest particle. This mixture gives a very smooth wall and little additional work is necessary after the removal of the forms. While such a wall is durable, yet its compressive strength is rather low, but experience has shown that it is amply strong to support a roof of ordinary wood construction, the type which is ordinarily used. With a roof of heavy tile, such as is shown in Figs. 1 and 6, the use of a 4-in. wall would not, in the writer's opinion, be considered good practice where the outside walls carry the entire roof. As an added factor of safety, and to prevent cracks that have occasionally appeared in the 4-in. walls, specifications that call for a solid concrete wall have been changed to a 6-in. wall. The chief advantage of the use of screenings is the pleasing texture of the finished surface.

The concrete is mixed by hand to a wet consistency and the wall is poured in courses 3′ high around the entire outside. The forms are removed 24 hrs. after pouring the concrete and the wall, while still "green," is rubbed down with a wooden float. In this way the rough spots are eliminated without discoloring the surface. For such a thin wall special care is exercised in placing and bracing the forms to keep them true and plumb.

Floors—The floor is usually constructed of wood, using joists 2″ x 8″, 18″ o. c., supported at the outside on the footing wall and at the center on a girder set on concrete posts. One-in. sheathing is laid directly on the joists and the finished flooring after the other parts of the building is complete. If tile floors are specified, the tile are laid on a concrete base over a well packed earth fill. The floors of the bath room and of the kitchen are gener-

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[1] From Concrete, Sept., 1915, p. 100

[2] Res. Engr., Trussed Concrete Steel Co., San Juan, P. R.

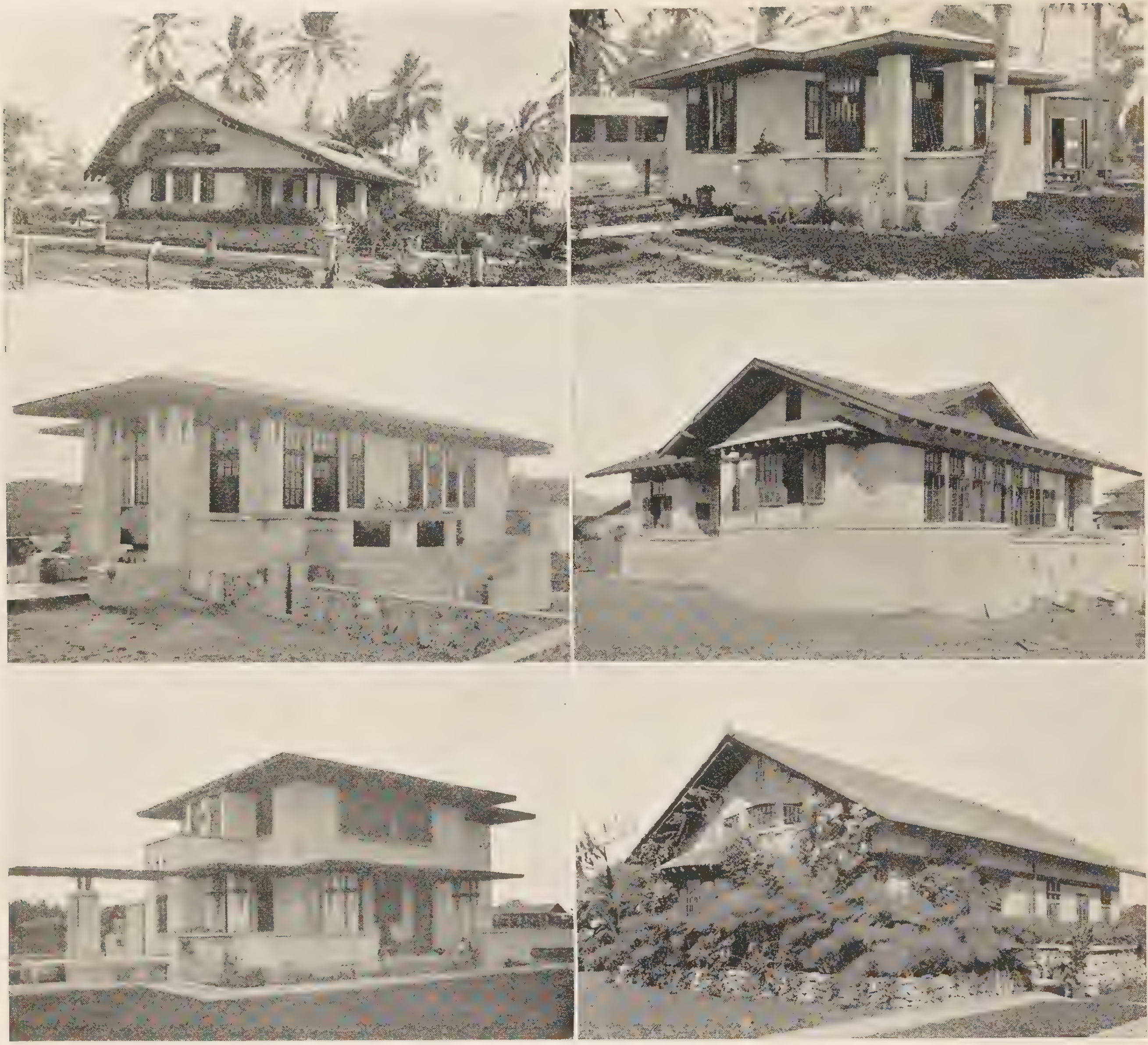

Fig. 1—A Group of Concrete Houses at "El Condado," Porto Rico

ally of tile and concrete respectively. The top surface of all concrete floors is treated with a hardener to prevent wearing and dusting.

Partitions—All interior partitions are constructed of Hy-Rib[3] and plaster, except where a center support is necessary for the roof joists, in which case the center longitudinal wall is of solid concrete. The partitions are 3″ thick and are laid directly upon the wood floor, the floor joists being doubled under the partition. They are reinforced at the corners and at the sides and the top of door openings with 1½-in. structural channels vertically, and ¼-in. round rods, attached to the Hy-Rib, horizontally, 18″ o. c. The mortar applied to these partitions consists of 1 part of Portland cement, 3 parts of sand and a small amount of lime, usually 10% of the cement. The interior of the outside walls is also plastered to conform in color and texture to the plaster partitions.

All concrete and plaster are waterproofed with an integral waterproofing, as well as all concrete floors that are laid on the ground.

Roofs—If the width of the building will permit, the roof joists span the outside walls. Roof construction is of the ordinary frame type and is clearly shown in the accompanying plans. The roofing material used depends upon the fancy of the owner and is of asphaltic paper, metal tile, Spanish clay or vitrified tile. The clay tile are not used to a very large extent, owing to their exceptionally high cost. The pitch of roofs is very flat and the overhang varies from 3′ to 4′, either ceiled or left open. If ceiled, special care is taken to allow circulation in the attic by providing at intervals screened openings in the ceiling.

Details of Finish—The tendency of the Porto Rican is toward rather bright colors and panels of faience tile are inserted in certain parts of the outside wall, usually on the sides of columns and at the lower corners of windows. These panels are shown in the accompanying views. The windows are a very important factor in the construction of these dwellings, as it is imperative to obtain the maximum ventilation and, on the other hand, not admit too much sunlight. As before mentioned, this is ordinarily accomplished by the use of shuter windows. These windows are also generally placed in groups so that when they are open the room will practically be converted into a veranda.

These residences contain nearly all of the conveniences of a modern suburban American home, such as water service, electricity, gas, etc. However, except in the business district of San Juan, there is no sewerage system. Sanitation, therefore,

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[3] Trussed Concrete Steel Co., Youngstown, Ohio

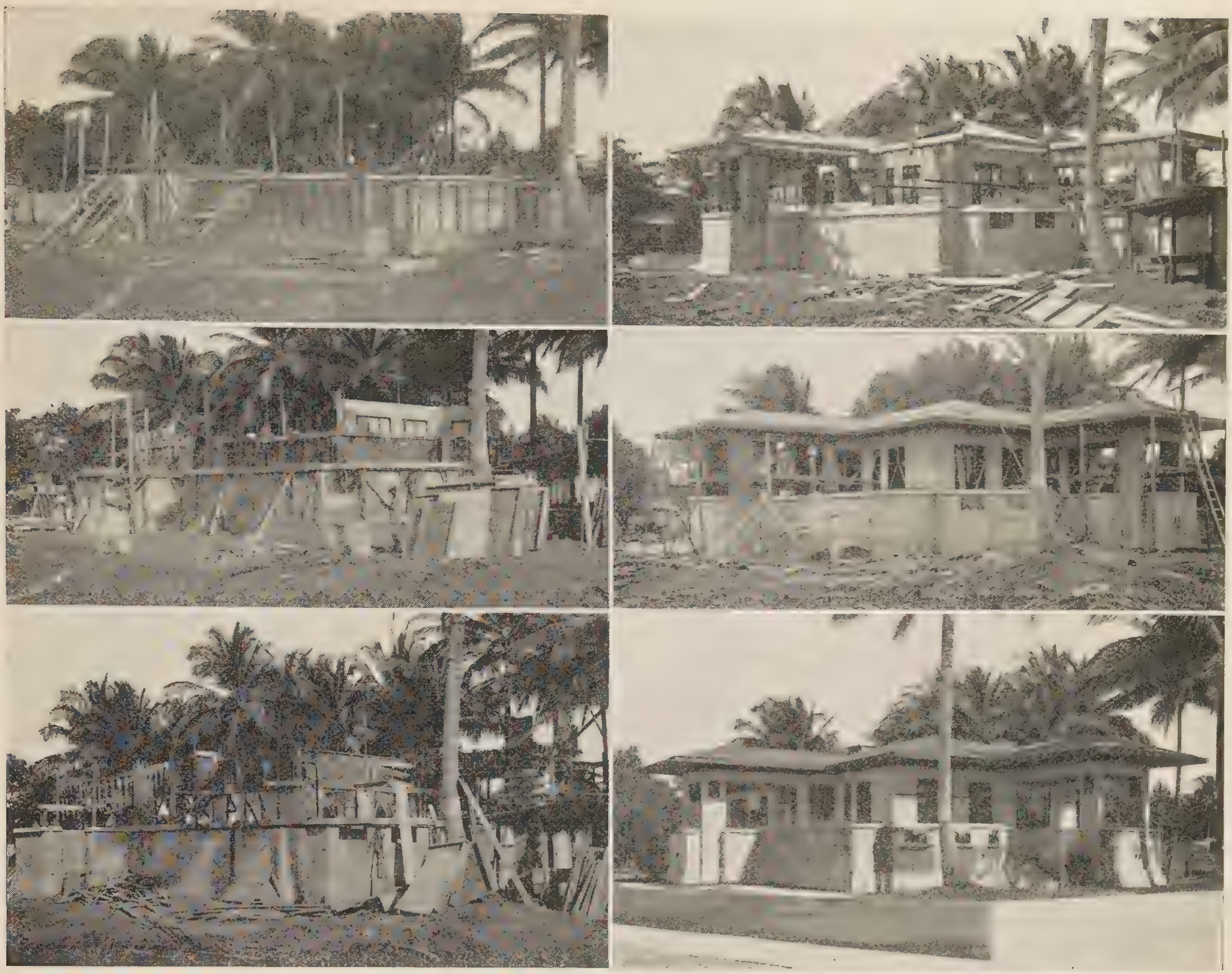

FIG. 2—CONSTRUCTION VIEWS OF HOUSE FOR BEHN BROS., EL CONDADO, PORTO RICO

requires that each residence must dispose of its sewage. The system consists of two tanks placed well under ground, one of them constructed of concrete and practically air-tight. The second tank is constructed of loose stones through which the sewage water percolates. The solids are retained in the first tank and the fluid is drained into the second, where it seeps out through the ground. The air-tight tank will require cleaning about once a year and the outlet tank, if constructed properly, will never require any attention.

These residences are in the residential park, "El Condado," which contains practically all the homes of this type. The dwellings are designed by local architects and are built by local contractors, either under the supervision of the owner or through Behn Bros., who are financing the development of this section.

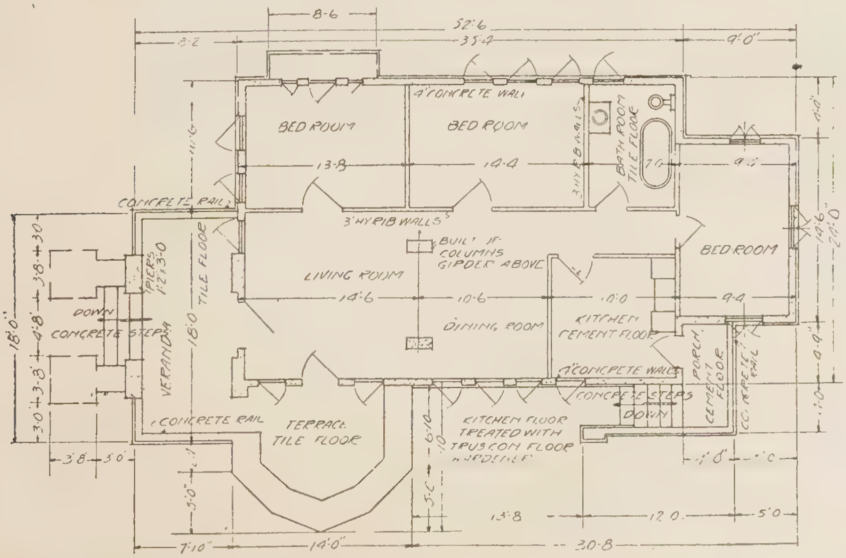

FIG. 3—FLOOR PLAN OF BEHN BROS. HOUSE

COSTS

It is rather difficult to obtain unit cost figures. Very few contractors keep a cost system in a systematic way and consequently most of them cannot give the cost of a certain kind of concrete on the unit basis. However, the following figures are an average of most of the structures illustrated and represent quite closely the actual cost:

LABOR AND MATERIAL COSTS, CONCRETE RESIDENCES IN SAN JUAN, P. R.

MATERIALS (Cost at Job):	
Cement, per bbl. gross (less 28 cts for return of 4 sacks)	$1.80
Broken stone, ¾-in., per cu. yd.	$2.30
Stone screenings, ¼-in. to dust, per cu. yd.	$1.15
Sea sand, per cu. yd.	50 cts.
River sand, per cu. yd.	$1.90
Rough dimension and sheathing lumber, per 1,000 b. m.	$28-30
Finished Y. P. lumber for formwork, per 1,000 b. m.	$30-32
Quarter-sawed Y. P. flooring, per 1,000 b. m.	$65-70
Reinforcing steel, per ton base	$41.50
P. R. mosaic tile for floors, per sq. yd.	85 cts.
Red quarry tile for roof (U. S. mfre.), per sq. yd. of roof	$2.50

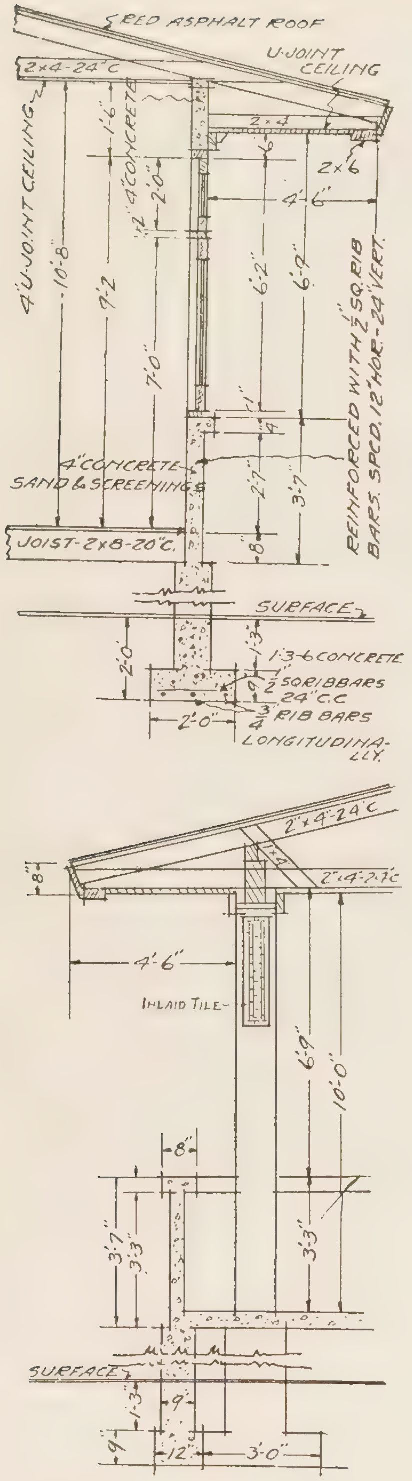

Fig. 5—Section Through Porch

Holland clay tile for roof, per sq. yd. of roof	$1.20
Metal lath for partitions, with studs, per sq. ft.	2.5 cts.-3.0 cts.
Hy-Rib or similar for solid partitions, per sq. ft.	5 cts.-7 cts.
Labor and Materials:	
Footing concrete, 1:3:6, labor and materials, per cu. yd.	$9.00
Wall concrete, 4"-6" thick, labor and materials, per cu. yd.	$18.00
Floor concrete on earth fill, labor and materials, per 100′ (5" thick), (no top dressing)	$12-14
Hy-Rib partitions, 3" thick, per sq. yd.	$1.75
Studded partitions, 6" thick, lath and plaster both sides, per sq. yd.	$2.00
Plaster and concrete, ¼" thick, per sq. yd.	35 cts.
Rub finish on outside wall (where not plastered), per sq. yd.	13 cts.
Finished wood flooring, labor laying, per sq. yd.	13.5 cts.
Finished wood flooring, labor finishing and scraping, per sq. yd.	16.0 cts.
Wood floor joists, 18-in. spacing, labor, per 1,000 b. m.	$20.00
Tile floor, labor, per sq. yd.	$1.00
Peon labor, per hr.	10 cts.-12 cts.
Carpenters, per hr.	25 cts.

Average cost of buildings, complete, including plumbing, electric work, etc., for one-story residence as described in article is $1.75 per sq. ft. of floor area, including balconies.

Build Fireproof Homes

Standing guard at a blackened ruin, where the charred remains of what was a home are a wet, black mass in the hole that was the cellar,—we have all seen the chimney, standing stark and grim, a warning to men to build of fire-resisting materials.

Men are inherently fire-worshippers. From earliest times—around fires of many kinds—have grouped the mystery and the magic of the developing races. In what we have been but very recently prone to call our "modern homes," burnable wood construction, wood walls, floors, roof and stairs, fire has been our servant, our enemy, and too often our demon master.

Fire should be man's friend—to serve and comfort him. In the dread of fire, in that state of living in constant fear of fire—in that necessity of constant precaution against destruction by fire—in your very home—in the heart of your home, the fireplace—mankind is losing much.

Leave out the toll of lives and the loss of property, and consider alone the damage—not measured in personal or material terms—but the damage wrought by fear and anxiety.

One incident illustrative of this comes to mind at this time. There was a home on a hillside in a Jersey suburb in a frame cottage. The neighbors, too, lived in frame cottages which dotted the hillside. In a short twenty minutes one spring afternoon — with everybody awake and about—fire changed one of the houses to a blackened ruin. What household goods could be saved were piled in neighboring yards. Can such tinder-boxes be called *homes?*

Today, in a 30-year-old brick house, wooden floored, in the upstairs nursery, an open grate fire is the center of interest. A banked fire kept through the cold nights, is a comfort. A live coal falling out of the basket—a defect in the chimney—any one of many possibilities—would convert that house into a furnace, with us inside.

Under such possibilities for destruction, we have in the past been compelled to live. We have had to house our wives and children, shut up — locked in — in tinder-boxes—nursing the demon fire in their midst. If all the hours of fire and worry caused by the possible fires in American homes could be summed up, what an appalling total it would mean. We have paid bitterly for tinder-box construction of American homes. The currency has been human lives and happy homes. We have learned to fear fire and to hate it.

This is not a discussion of concrete houses—so much as it is an earnest plea for *fireproof homes.* Consider today what is offered the modern house-builder. For exterior wall construction concrete, block or poured, tile, stucco and brick—each makes its appeals in different ways. In the long run and all things considered, many of them are cheaper than clapboards. The emphasis today must be placed on fireproof floor, stair and roof construction. For fireproof construction of these parts concrete in some form or another is absolutely essential from every practical standpoint. At a given cost, concrete, in walls, floors and roofs, offers to the home builder the biggest value in every way.

Consider the contrast in modern fire-resisting concrete home building. A fireplace is put up on the roof where it can be enjoyed by all, where the air and sun and sky and stars and fire are true companions. In another home (shown in this issue) a fire burns in a basket in the center of the room; a hooded smokestack carries off the smoke. The fear of fire, the worry and anxiety over it, are banished for ever.

It has been said that a man's home is his castle. Is it true so long as the traitor demon, fire, is nourished within? Is it not true only when the house is fire-resisting in every part?

The Concrete Porch

Concrete as a better material for porch construction is making progress, but thousands of houses are still being built in which wood is used for this exposed portion of the building. The porch is usually the first part of a house to be replaced and particularly so since less durable woods have replaced pine.

Concrete is the logical material for porch and steps. It is permament, it is inexpensive, it is clean and attractive. To use less permanent material except on the frame house seems inconsistent and on the frame house the concrete porch makes permanent this troublesome detail and cannot fail, as time passes, to educate the owners, tenants and other observers to the value of concrete as a house building material.

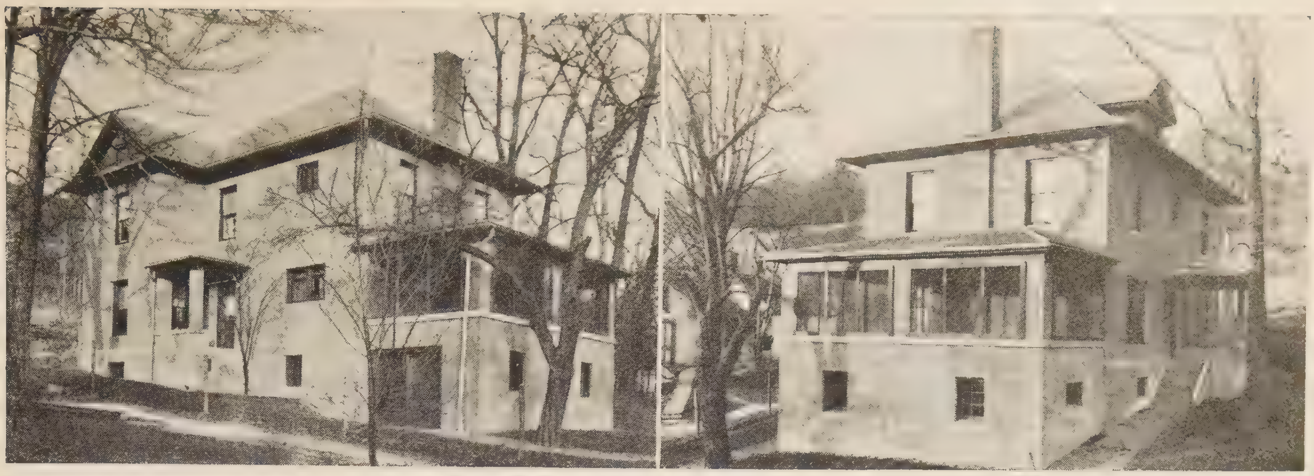

Fig. 1—Two Views of Concrete House with Double Walls, Built in Binghamton, N. Y., for $3,500

Six-Room House, Double Concrete Walls, Costs Complete, $3,500[1]

The 6-room house shown in the accompanying illustrations, 24′ 6″ x 36′ 6″ in plan, has double concrete walls and was built complete last season for $3,500.

It is the home of Otto W. Gall, Binghamton, N. Y., designed by himself and built by William S. Snyder, contr., Binghamton. Information as to the construction and costs is supplied by Mr. Snyder.

Added to the principal plan dimension given is a porch 10′ x 23′. The cellar is 7′ 6″ in the clear; height of first floor 9′ 3″, second floor 8′ 10″, full height of house to roof plate, including cellar, 26′ 6″. A Van Guilder[2] hollow wall machine was used in the construction.

The material required for outside walls including footing; cellar walls, superstructure and porches, was 116 cu. yds. of bank-run sand and gravel, at $1.25 per cu. yd.; 124 bbls. Atlas[3] cement at $1.40 per bbl. The concrete was mixed 1 part cement to 6 parts sand and gravel; $28 worth of wire ties and reinforcing were used. Workmen employed were: one operator on hollow wall machines at $4 per da., and four helpers at an average of $2.25 per da.; 21 das. were

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[1] From Concrete, Jan., 1915, p. 47

[2] Van Guilder Hollow Wall Co., Rochester, N. Y.

[3] Atlas Portland Cement Co., N. Y. C.

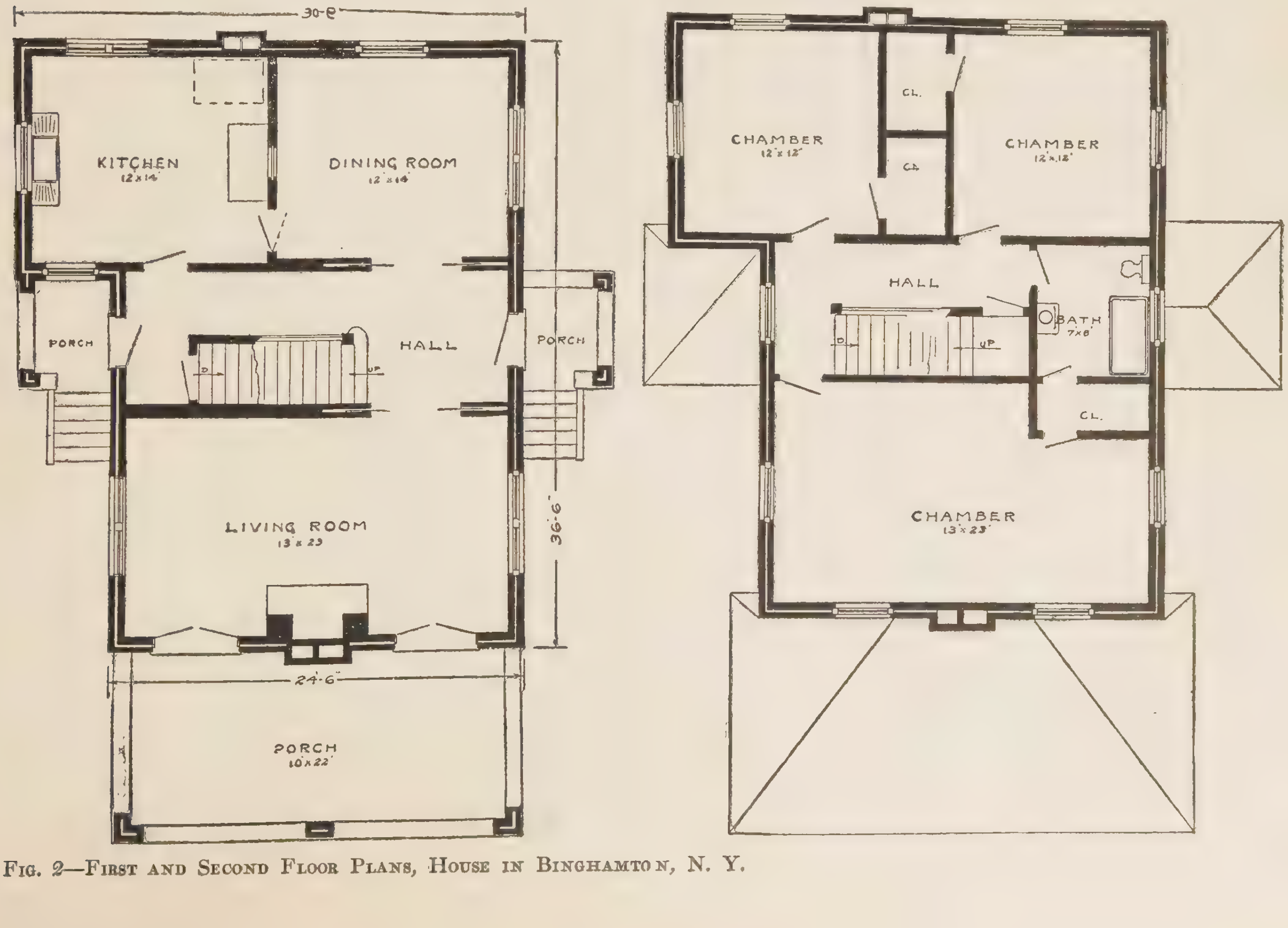

Fig. 2—First and Second Floor Plans, House in Binghamton, N. Y.

occupied in the work. A mixer with a hoist attached[4] for carrying the concrete to the double wall machines was used. A charge of $1.00 per da. was made against the house for the mixer.

The footing under the cellar wall is of oslid concrete 18″ wide by 12″ deep. The cellar walls, 8′ high, have an outside wall 6″ thick and an inside wall 4″ thick, with a continuous air space between them, but are bound together by many galvanized iron ties with bent ends running from the middle of one wall across the air space to the middle of the other wall.

The superstructure and porches have double 4-in. walls with the same air space and ties. Each wall is reinforced with wire all around the building every 9″ in height. The chimney is a part of the concrete wall itself.

The entire cost of the concrete work on this house, including footing, cellar walls, superstructure, porches and chimney, was $640. The cost of the walls, including 1 ct. per ft. for investment in machines and depreciation, was 16 cts. per sq. ft. of wall surface. No wooden forms were used; the machines did all the work except the steps leading to the porches and the chimney above the roof.

Plaster is applied directly on the inside walls, the insulation provided by the air space making furring and lathing unnecessary. Dampness will not penetrate the interior and condensation is prevented. The amount of plaster required is somewhat less than when placed on lath.

The stucco finish is applied directly on the outside walls, the machines leaving a rough surface for its application. On this house three coats were used composed of light colored sand, Atlas cement and hydrated lime. The third coat was applied with a whisk broom, producing a whip effect. The walls are entirely of concrete and steel.

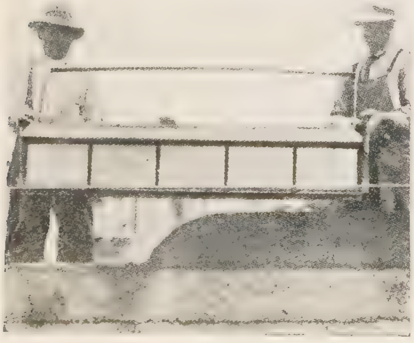

Fig. 3 Wall Machine in Use

Inside the house the first and the second floor are double; first floor finished in oak; second floor finished in N. C. pine; floors filled and varnished; all partitions throughout house, except where sliding doors run, are 6″ thick; partitions where sliding doors run, 8″ thick; floors of kitchen and bath room of composition flooring; kitchen trim, N. C. pine, natural finish; all other trim of lower floor, including stairway, cypress, finished with one coat dark mission stain; all second floor trim, N. C. pine, three coats white enamel; hot air heat; electric lighting; straight gas kitchen. Outside trim, cypress stained with tobacco brown creosote; slate roof; cost of house to the owner, complete, $3,500.

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[4]Jaeger Mach. Co., Columbus, Ohio

Living in Concrete Houses[1]

A Letter from L. N. Babbitt[2]

I am glad to make a statement as to the living conditions as we have found them in our concrete houses during the last three years. These houses, it will be remembered, were built by Mr. Hazen, Mr. Fuller and myself, in 1910, and were described in the May, 1911, issue of *Cement Age*. Briefly, the houses are of solid reinforced concrete with reinforced concrete floors and stairs. The roofs are of tile on wooden rafters and decking. The outside walls are 8″ and 6″ thick and are furred on the inside. A 1-in. air space is left between the wall and the plaster on metal lath. The bearing walls and the ceilings were finished by rubbing smooth with carborundum brick and left in this condition. The partition walls are plaster on metal lath. The floor surfaces in the three houses are oak for the second-floor sleeping rooms, tile and concrete for the living rooms. The cost of these houses was $7.50 per sq. ft. of gross area. This included ⅓ of the porch area.

After our experience of four winters, I can say that we much prefer this type of construction to the frame dwelling. The past winter has been unusually severe, with zero temperatures accompanied by very high winds. In spite of our exposed position the wind and weather have in no way affected the interior comfort of our houses. One thing stands out forcefully, and that is the solidity and tightness of the concrete house in a high wind.

In my own house, of about 1,200 sq. ft., I have burned about 12 tons of coal each winter, and every one of our 10 rooms has been comfortable. From our own experience the heating proposition presents an interesting point. The temperature of our main floor rooms has seldom been above 70° F. and with very few exceptions has not been below 60° F. In other words, during the entire winter the hot water system has been so operated as to keep the rooms within a range of 10°. This, of course, does not apply to the sleeping rooms. This regular temperature is possible because the concrete partition walls and floors seem to absorb any excess heat, and if the fire gets low at night the radiation from the concrete keeps up the room temperature. Another point is that with solid floors there are no drafts and the difference in room temperature between the floor and ceiling is very little. I have no figures on this, but it is nothing like the rooms in some frame houses where the difference is sometimes more than 10°. Perhaps the reason for this even temperature is the heat in the concrete floors, and perhaps also very slight convection currents produced by the outside walls, which, while furred, must have some effect upon the room temperature.

In summer time the houses are very comfortable and I think have an advantage over the frame house in evenness of room temperature. That is, the interior does not fluctuate with the mid-day heat.

We have not experienced dampness at any time.

Our concrete floors we have found comfortable and easy to take care of. After our experience with oak, concrete and tile, our choice would be the latter. A good quality of tile, well laid, is decorative, comfortable and can be kept immaculate. Where children are in evidence, and several times a day bring in snow, mud and water to the main hall, the tile is much to be preferred, as all that is needed is a mop to restore it to its original condition.

The exteriors of the houses seem to improve with the weathering, and both exteriors and interiors have proven satisfactory. There has not been the slightest settlement in any of the three houses.

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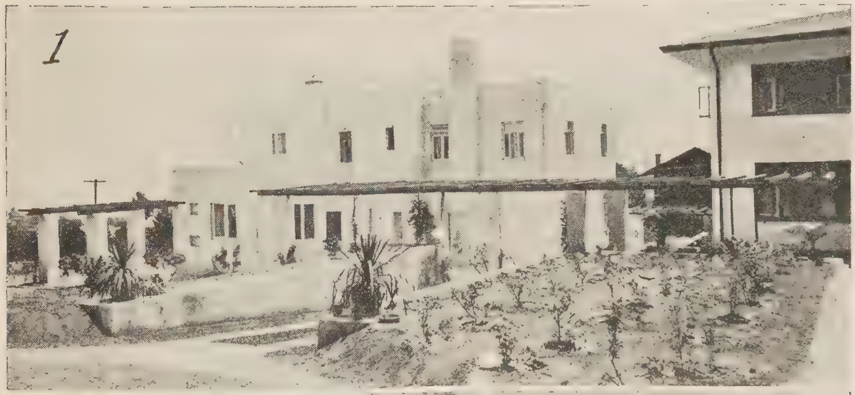
[1]From Concrete, Correspondence Dept., Apr., 1914, p. 90

[2]Secy., Hazen & Whipple, Consult. Civil Engrs., N. Y. C.

In regard to the matter of training vines on concrete surfaces, there is one vine only that I know of which will stick, and that is the Ampelopsis Vechii, or Japanese ivy. This does pretty well but sometimes the high winds tear off the small ends. The vine is prolific and I think will stick permanently to a concrete wall. The English ivy is much prettier to my mind, and I have planted some of this. It has not gotten well started and when it does I expect I shall put a trellis for it to grow on.

Not a dollar has been spent for repairs and no insurance is carried. To our way of thinking the concrete house is a much superior type of construction, with many advantages and none of the disadvantages which are encountered even with well built frame dwellings.

A California Concrete House With Pre-Cast Walls[1]



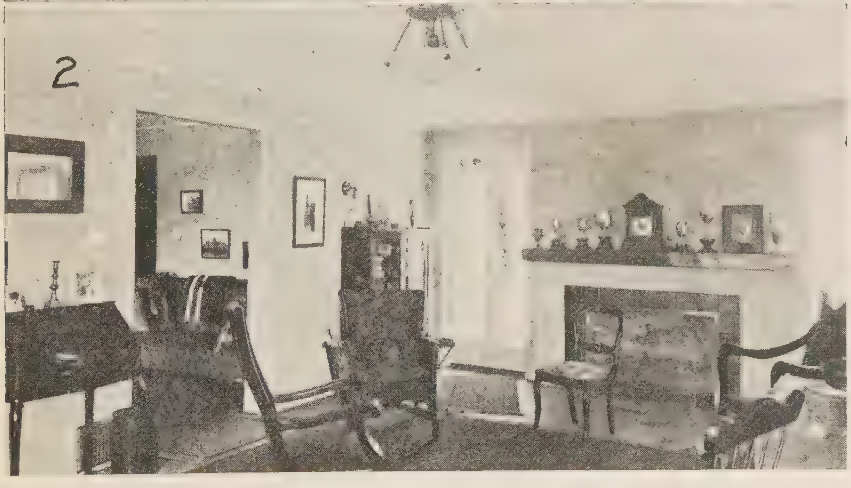
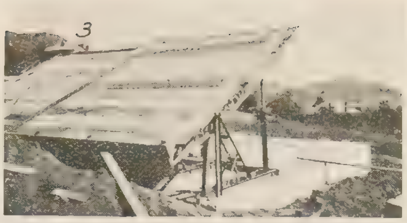
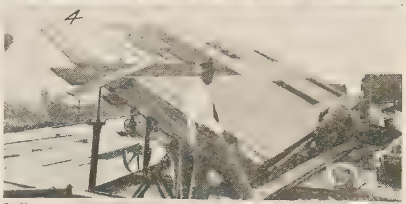


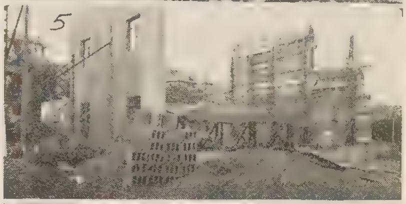
FIG. 1—CONCRETE HOUSE WITH PRE-CAST WALLS AT HOLLYWOOD, CAL.

FIG. 2—INTERIOR, SHOWING CONCRETE AND TILE FIREPLACE

Note the sanitary finish of door and window openings and absence of wood trim







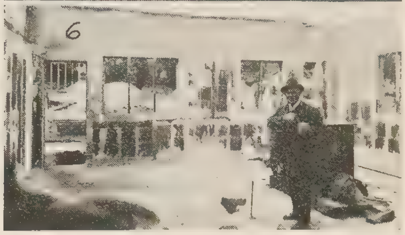


FIG. 3—FORM READY FOR CONCRETE

FIG. 4—READY TO RAISE A WALL SECTION

FIG. 5—THREE STAGES OF CONSTRUCTION

At the left a wall is in position. At the right the wall has just reached its place, while in the foreground a form is ready to receive the wall

FIG. 6—WALLS READY TO PLASTER

Early in the history of concrete construction, Col. Aiken, U. S. Army, devised a system of casting the walls of buildings in a horizontal position and raising them with special equipment. Numerous buildings were erected, notably at army posts, but the system was not widely used. Recent developments indicate increasing interest in the possibilities of this plan.

In the construction of a concrete house at Hollywood, Cal., the walls were pre-cast in a horizontal position and raised by motor-driven jacks. The house was designed by Irving J. Gill[2] and erected under his supervision.

After the foundaiton for the house had set the floor slab was laid and on this jacks for the erection of the walls were placed, which are well shown by Figs. 3 and 7. Twelve feet of floor space from the wall to be erected was required in which to place the jacks, on which tilting tables, built of 2-in. x 6-in. rough plank, were laid over steel walking beams. The number of jacks used and the spacing of them depended on the weight and size of the wall to be supported.

Door and window openings were laid out, the metal jambs set in place and the remaining surface of the wall form covered with hollow tile spaced for reinforced concrete beams to give proper stiffness; twisted steel rods were then placed vertically and horizontally and the wall was ready to be poured. Concrete was wheeled up an incline, dumped, leveled off and allowed to set. The upper surface (the outside of the wall) was finished in its tilted position before being raised.

The power for erection was obtained from a 5-h. p. gasoline engine and transmitted to the jacks by a shaft through their pedestals. A worm gear mechanism extended all jacks at exactly the same rate.

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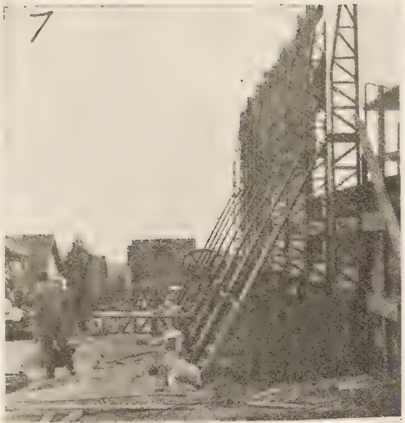
[1] From CONCRETE, May, 1916, p. 197

[2] Archt., San Diego, Cal.



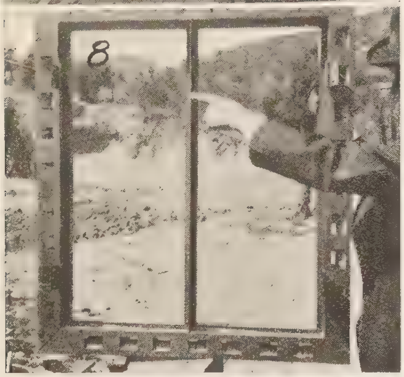


Fig. 7—Raising Equipment
Fig. 8—Metal Window Frame

From ½ hr. to 2 hrs. was required to raise each wall, the time depending on the weight, shape and position of the wall.

Horizontal rods left projecting from the ends of the walls were bound together after two adjacent walls had been raised to an upright position. A form 2′ wide was built up the entire height of the wall and into this concrete was poured, producing a concrete and hollow tile shell reinforced with twisted steel bars.

CONSTRUCTION DETAILS

Roof joists are held in place by anchors for which provision had been made in the concrete wall and 1-in. x 6-in. sheathing covered by a gravel composition was used for the roofing. Interior partitions are of metal lath on wood studding and the rough concrete floor slab has been covered by a finish coat reinforced with wire cloth.

Special metal door and window frames[3] were used manufactured from No. 22 ga. galvanized iron bent to shape and provided with perforated flanges through which the concrete forms a key. The plastering finishes flush to the corners of the frames which act as a corner bead for both exterior and interior wall surfaces. Each side of the frame is bent from one piece of metal so there is no danger from cracks.

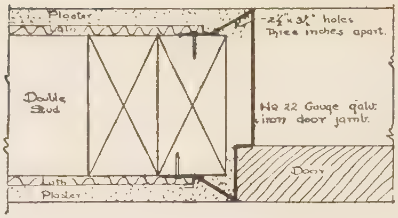

Plaster
Lath
2¼" x 3½" holes three inches apart.
Double Stud
No 22 Gauge galv. iron door jamb.
Door
Lath
Plaster

Fig. 9—Detail of Metal Door Frame

Sanitation and fireproofing are the features of the finish as well as the structural details. There are no moldings or panels on the doors, simply plain slab surfaces easily cleaned or dusted, while the absence of baseboards, ceiling beams, plate rails, door and window casings and picture molding makes the house as nearly dirt proof as is possible.

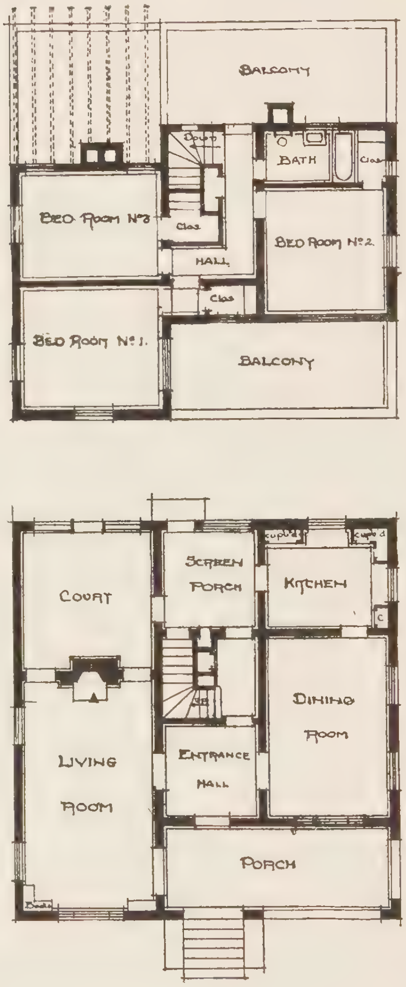


Fig. 10—First and Second Floor Plans

The experience gained in the construction of this house indicates that it has possibilities for economy that will recommend its more extended use.

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[3] Patent applied for, Irving J. Gill

When lapping the ends of reinforcing rods they should not be closely wrapped with wire; the concrete must have free access to all parts of the steel.

"Worked Out" Details in Concrete House Construction[1]

By A. Morgan Smith[2]

Present-day building materials and modern requirements make the residence more substantial, and materials that are liable to rot or rust are largely eliminated.

Beginning wiith cellar wall, cellar floor, porch floors and steps, concrete has made possible the first advance toward permanent residence construction; even today all houses of any consequence include these features in concrete and the same conditions and circumstances that favor this good start are just as favorable toward completing the residence with concrete. Just as soon as the builder becomes more familiar with the use of concrete in residence construction the concrete house will be an everyday proposition and entirely practicable for the man wanting permanence, the lowest up-keep cost and nothing to fear from fire.

Conventional ways of building with other materials, such as an 18-in. cellar stone wall, increased wall full height for chimney bearings and 13-in. walls for first story, handicap the use of concrete,—but when it is clearly understood that a concrete wall will distribute and withstand different stresses more safely than a wall of stone or brick of the same thickness, it is apparent that material can be saved by using a thinner wall of concrete.

For the average two-story house with 7-ft. cellar a 10-in. cellar wall and 8″ for the first and the second story wall is heavy enough. Reinforcing steel should never be omitted; with the slight extra cost, the fear of cracks is overcome.

Two ⅝-in. bars should run continuously in all walls and partitions just over window and door heads. Local conditions better determine the quantity and placing of vertical steel.

Inside partitions should be about 4″ or 5″ thick. Grounds for base rails, etc., with grooves for wiring and piping, must not be overlooked. Small holes for pipes are easily provided by wrapping a few layers of heavy paper around a stick and placing where the hole is wanted. The paper makes removal an easy matter.

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[1] From Concrete, Jan., 1915, p. 17

[2] Archt., Mt. Lebanon, Pa.

Forms for the cellar wall and the first-floor slab should be built at the same time so that the wall and the slab may be poured integral and likewise the walls and slabs for the first and the second story.

The outside walls should have air space provided with 7/8-in. x 2-in. furring strips; the air space is recommended where zero weather is expected as the saving in heating fuel will pay for the air space and the house will be cooler in summer.

The thickness of the floor slab and amount of reinforcing required will vary according to the span and should be carefully worked out both in design and construction.

Tile or terrazzo floor may be laid on the floor slab at much less cost than over wood joists. Wood floors may be laid over the slab on wood sleepers in the usual manner.

The concrete roof is an important part, as is also for appearance the top part of the house, whether it is called the cornice or the parapet. Where the roof is flat, a combination roof and cornice works out well and is simple in construction. Fig. 1 shows one arrangement; the appearance here is extremely plain but it may be built to suit individual tastes or style of architecture.

The roof bears entirely on the cinder fill, allowing freedom for shifting due to change in temperature. Care must be taken in cementing in the brass flange and pipe and the pipe must clear the hole in the slab by at least 1/2″; a cheaper conductor may extend to the ground. Brackets may be placed at the corners and at intervals for support and appearance. The forms about this detail work should be well oiled to keep them from warping, which often causes cracks before the concrete is hard.

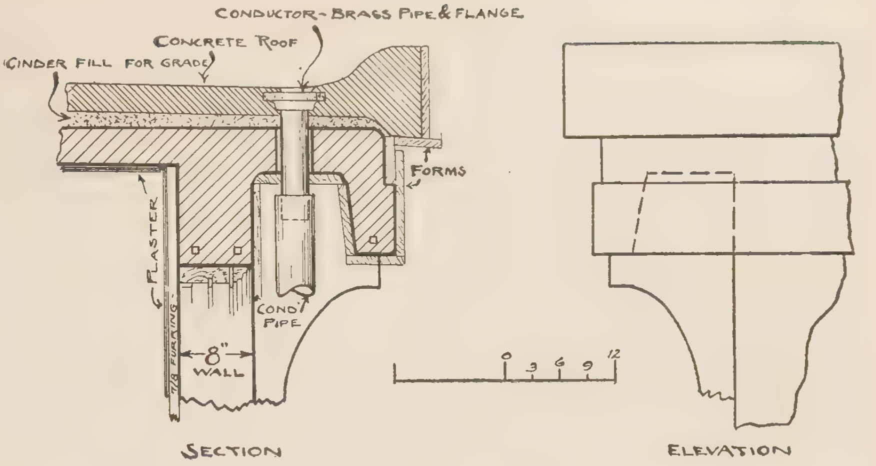

Fig. 1—Suggestion for Combination Roof and Cornice

Fig. 2 shows an arrangement of roof with parapet or guard wall. This wall is a means of safety where the roof space is utilized and when formed out on top is very suitable for growing plants or vines. About two layers of corrugated paper serve well the purpose here intended. It is collapsible under the roof expansion and the horizontal part makes easy the removal of the form board over it. My experience in roof construction has shown that Figs. 1 and 2 are very simple to build, are efficient and the work looks neat.

Cinders being light and not too dense when rolled to grade make a good inexpensive base for a concrete roof.

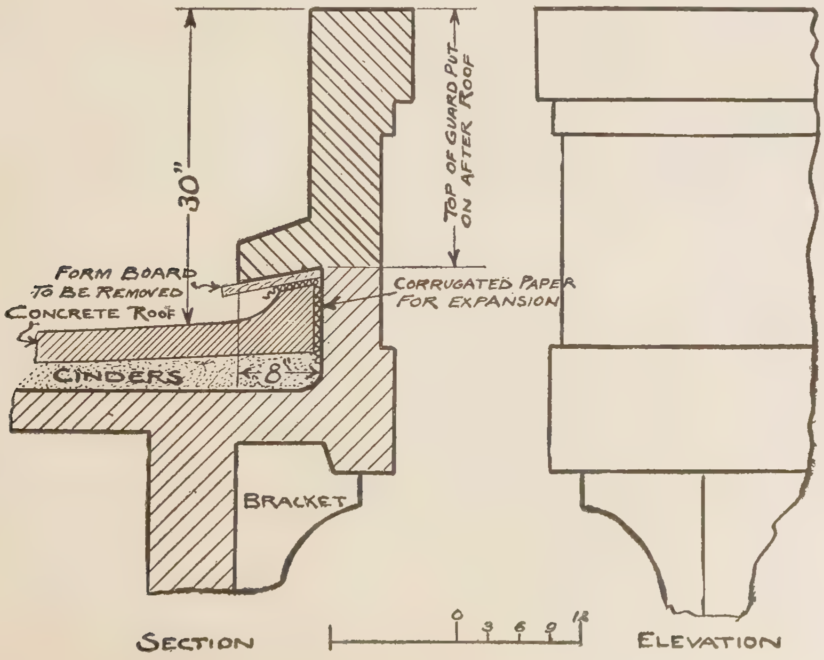

Fig. 2—Detail for Roof with Parapet or Guard

The roof should have a fall of not less than 1/8″ in 12″ and preferably about 1/4″ in 12″.

The outside finish for a concrete house whether it be a plastered coat of sand-finish, rough-cast or pebble-dash will surely be a permanent job. The sand or float finish should be given last consideration.

Concrete Filling for Tree Preservation

There is one man to look out for. There is no proprietor or superintendent who can afford to have Mr. Happy Hazzard—familiarly known as Hap. Hazzard—working for him.

On every hand are evidences of more serious attention to the matter of the quality of the sand, gravel and crushed stone which are to be used in concrete.

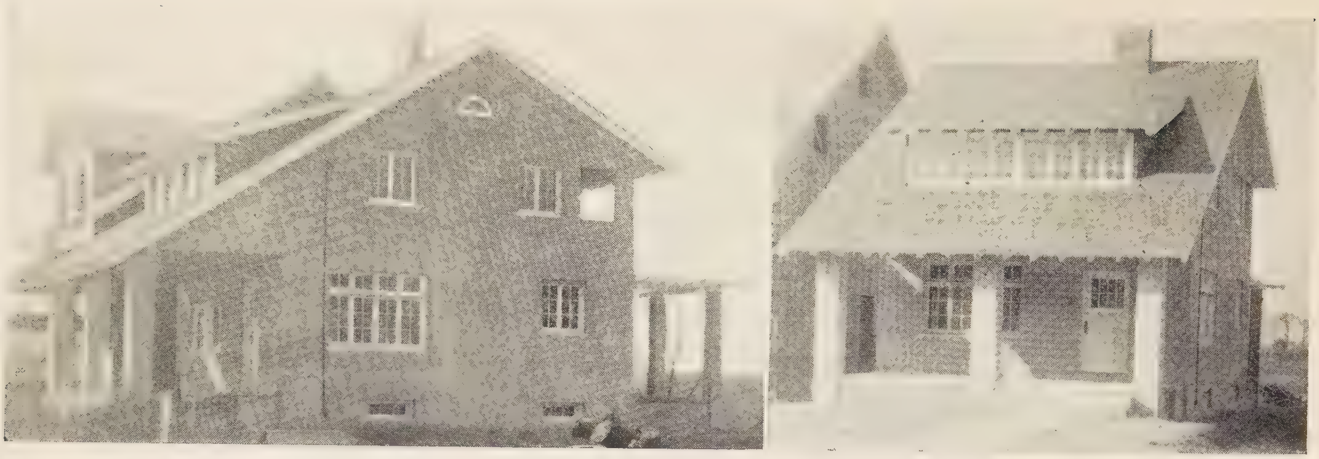

Fig. 1—Front and Side Views of Albany House Built of Concrete by New Method

Concrete Walls and Permanent Interior Form of Hollow Tile[1]

By C. R. Knapp

In building concrete houses where hollow walls are used it has been the general practice to use a movable core system, the core being moved up as fast as the concrete gets to the top of the core. I have used this method on a number of buildings but gave it up to use a 3-in. partition tile placed in the center of the wall making two 4-in. concrete walls with this 3-in. tile between. This way of producing a hollow wall has a great many advantages over the "pull-a-core" system besides showing a decrease in the cost. The saving of time more than overbalances the cost of the tile.

In building the concrete house here illustrated, I believe that I have made a still further advance in the hollow wall methods. The results fully bear me out in this belief. In this case instead of placing my hollow partition tile in the center of the wall I have used it for my inside form. This brings my two 4-in. concrete walls together, making an 8-in. solid wall and saving one line of steel reinforcement. The tile are held in place by a board or strip in front of the 2 x 4 uprights which are put in at regular spacing to match the 2 x 4's of the front forms. Reference to the drawing will show that the boards or strips that hold the tile in place come only at the joints where the tile open. There is in this method a great saving because it saves building the inside forms and leaves only one side of the concrete wall to look after. The tile are more easily hand-

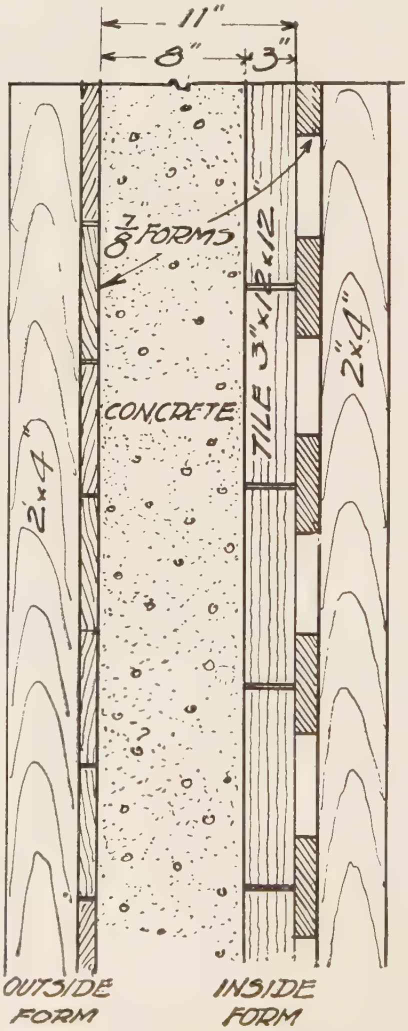

Fig. 2—Detail, Showing Method of Wall Construction

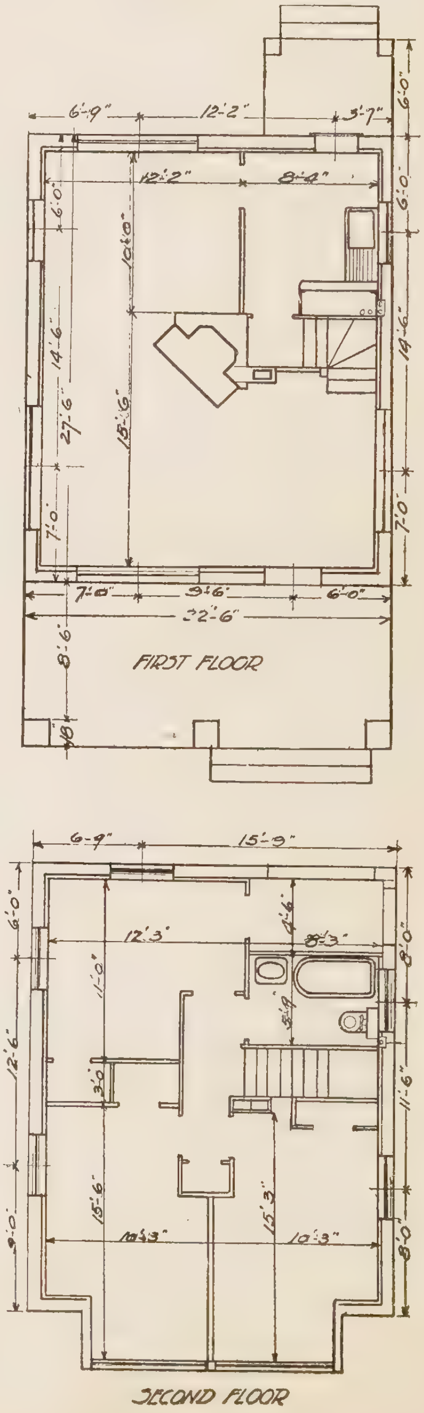

Fig. 3—Floor Plans

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[1] From Concrete, Jan., 1915, p. 22

led and can be kept in place better than when used in the center of the wall, and the air space is just as effective. In the finish of the inside wall the wall plaster is put directly on the tile, to which it adheres firmly.

The illustrations from photographs and the plans show the house built in Albany by the method described. It was built with idea of producing just a simple, cozy, homelike bungalow. It is a house built around a big fireplace. The openness or oneness of the lower floor, with no partitions except around the kitchen, is a special feature. Its large window spaces give plenty of good sunlight and these with the outdoor sleeping porch on the second floor rear show the owner's appreciation not only of light but of fresh air. The windows, all casements of a new style, are hinged in the middle and push out, the ends coming together.

The coal bin is under the front porch, sloping to a hole in the foundation wall near the heater, thus leaving no chance for coal dust in house. Cupboards for storage are built in foundation wall by using insets when concrete goes in. There is a beamed ceiling on the first floor.

The finish of the outer wall is bush-hammered at a cost of approximatory 3 cts. per sq. ft. The roof is of red asbestos shingles, thus giving a touch of color.

The finish of the woodwork inside is mission. The finish of the woodwork outside is painted white.

Concrete Block House, With Double Wall, Costs Less Than $2,500[1]

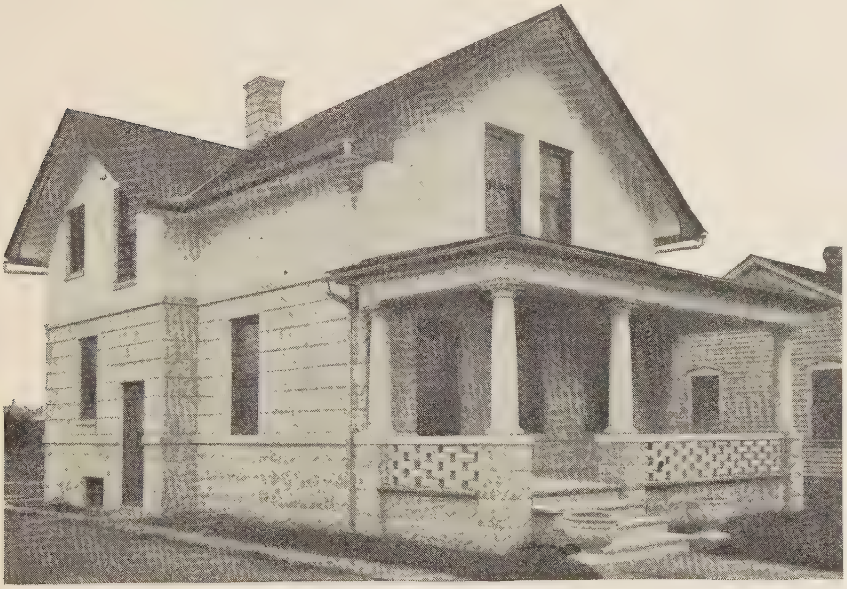

Fig. 1—Concrete Block, Double Wall House, Costing $2,500

The 7-room concrete block house shown in the accompanying illustration and in detail in the drawing was erected at Lake Geneva, Wis., by the Cement Stone & Brick Mfrs., for approximately $2,500, including plumbing and hot water heating system and also including profits. A distinctive feature of the house is the large wall unit, using 12-in. high block.

All of the walls are of double construction with an air space. The basement walls are 5″ thick on the outside and 5″ thick on the inside, with a 2-in. air space. Above the basement level the walls are of 5-in. block on the inside and 4-in. block on the outside, also with a 2-in. air space. The block in the basement walls, both sides, are 8″ high and 24″ long, and the block forming the inner wall above grade are also 8″ high, while those on the outside are 12″ high and 24″ long. All the block were made on a Hobbs[2] machine. Plain block were, of course, used below grade, and rock face granite block were used in the exposed portion of the foundation up to the water table. Panel face granite block were used over the water table to the second story height, with stucco on plain block from there to the roof. The porch columns, baluster work and other ornamental pieces were made in Simpson[3] molds.

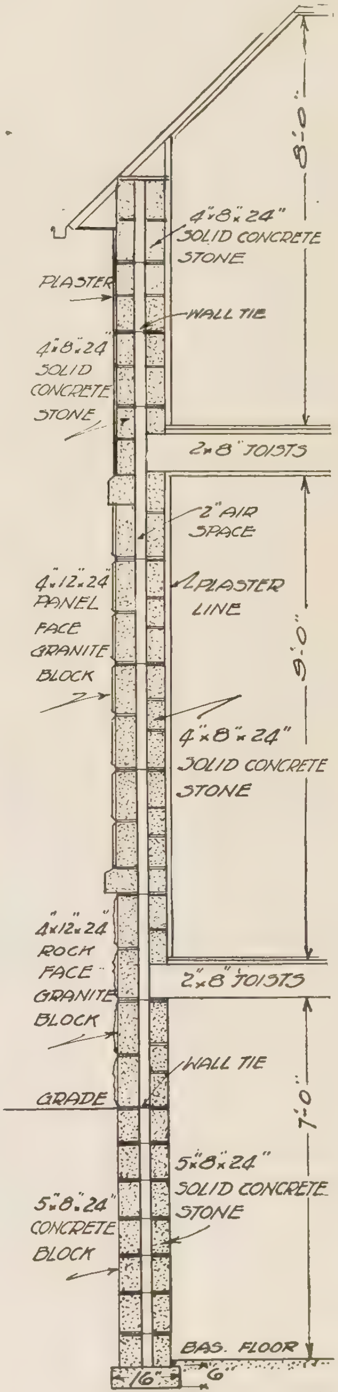
8′-0″
4″×8″×24″ SOLID CONCRETE STONE
PLASTER
WALL TIE
4″×8″×24″ SOLID CONCRETE STONE
2×8″ JOISTS
2″ AIR SPACE
4″×12″×24″ PANEL FACE GRANITE BLOCK
PLASTER LINE
9′-0″
4″×8″×24″ SOLID CONCRETE STONE
4″×12″×24″ ROCK FACE GRANITE BLOCK
2″×8″ JOISTS
WALL TIE
GRADE
7′-0″
5″×8″×24″ SOLID CONCRETE STONE
5″×8″×24″ CONCRETE BLOCK
BAS. FLOOR
16″
6″

Fig. 2—Wall Section of Concrete Block House

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[1] From Concrete, Jan., 1915, p. 44

[2] Hobbs Concrete Machy. Co., Detroit

[3] Simpson Cement Mold Co., Columbus, Ohio

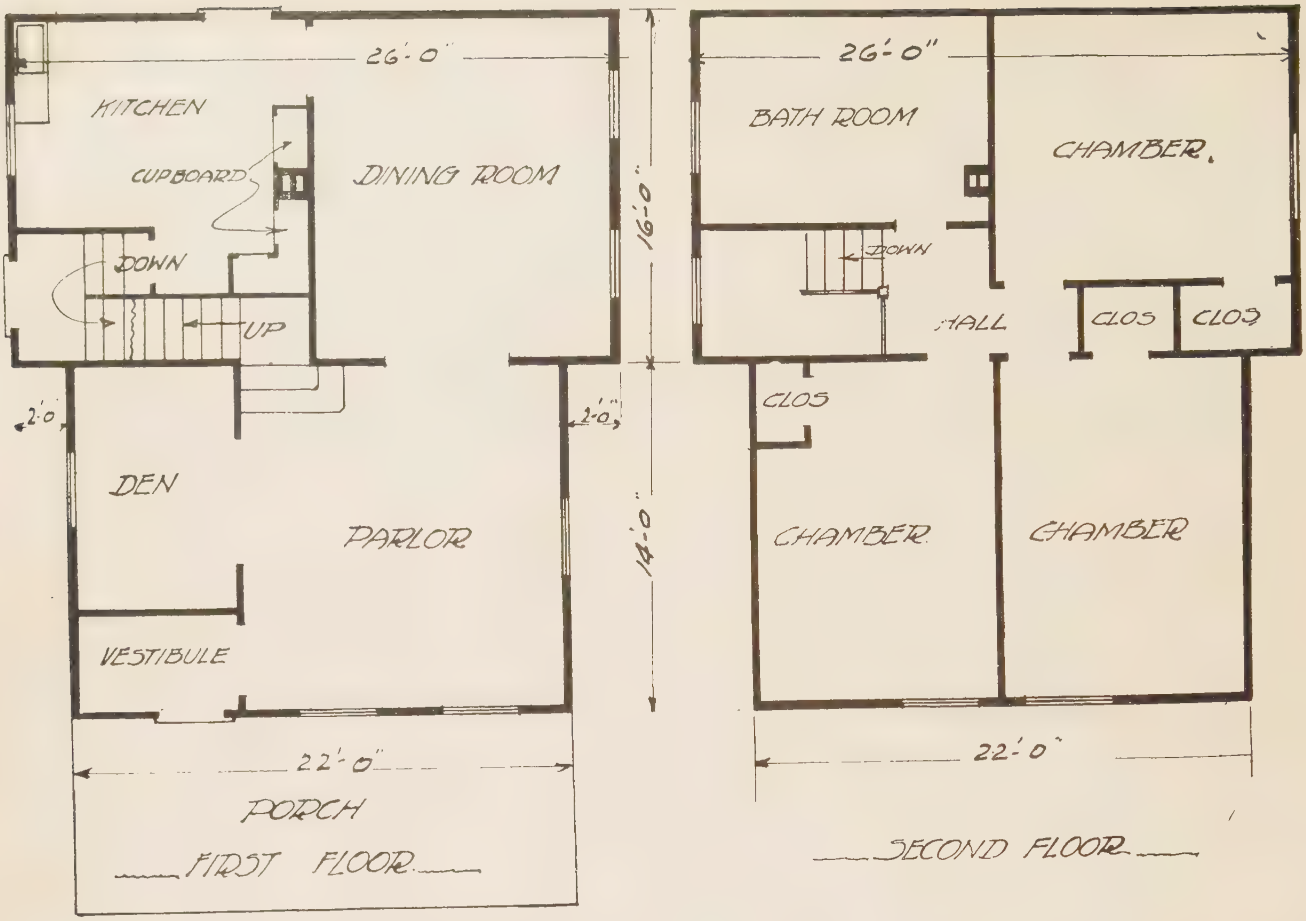


Fig. 3—Floor Plans, Concrete Block House Costing $2,500

In laying up the walls, wall ties were used with $\frac{1}{4}$-in. round material bent at each end. Manufacturers, in figuring the cost of the house, added to the cost of materials and labor a profit of 30%, this covering the manufacturing end only of the concrete work. The units required are listed as follows at the retail price:

940 solid stone, 5" x 8" x 24"	$103.40
1,500 solid stone, 4" x 8" x 24"	150.00
218 solid stone, 4" x 12" x 24", using a facing of granite and white cement.	54.50
332 solid stone, 4" x 12" x 24", granite face	83.00
10 window sills and caps, 3' 8" long, 4" thick, 12" high	15.00
15 window sills	13.50
80 pier stone, 4" x 12" x 12", granite face	12.00
5 porch columns	30.00
28 chimney block, 4" x 8" x 20"	5.04
80 baluster block, 4" x 4" x 12", rock face, two sides	8.00
202 lin. ft. water table, 5" thick, 6" high	50.50
25 lin. ft. hand rail	3.60
	$528.64

This gives a total of $528.54.

The excavation cost $40.00.

The mason work is itemized as follows:

Mason and laborers at $5.00 and $2.25 per da. of 8 hrs. respectively, laying block	$210.00
Pointing walls	30.00
Sand, cement and lime for laying block	28.00
	$268.00

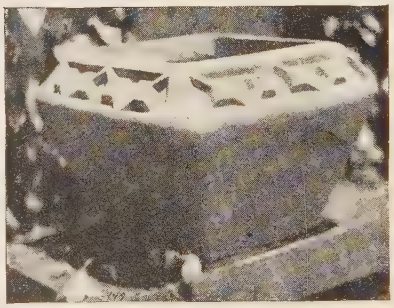
This gives a total, including mason work, materials and labor, of $796.54.

Rough lumber and mill work cost $565.00.

Carpenters at $4.50 a da. of 8 hrs., $360.00.

The stucco on the upper walls is in two coats—one of ordinary gray cement, and a finish coat of white Medusa Portland cement[4] and silica sand, with a cost, including labor and material, of 70 cts, per sq. yd.

The interior walls are plastered directly on the block, the air space being continuous. The roof is covered with shingles stained green. It is understood that the house made such a satisfactory appearance that the same company has had to build four more similar houses since.



To advocate the use of a material and then do a half-way job of manufacture or construction is an exhibition of the poorest kind of poor business sense.

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[4] Sandusky Portland Cement Co., Sandusky,

A Group of Concrete Houses Built With Steel Forms at Newark, Ohio[1]

BY GEORGE V. K. GREENE[2]

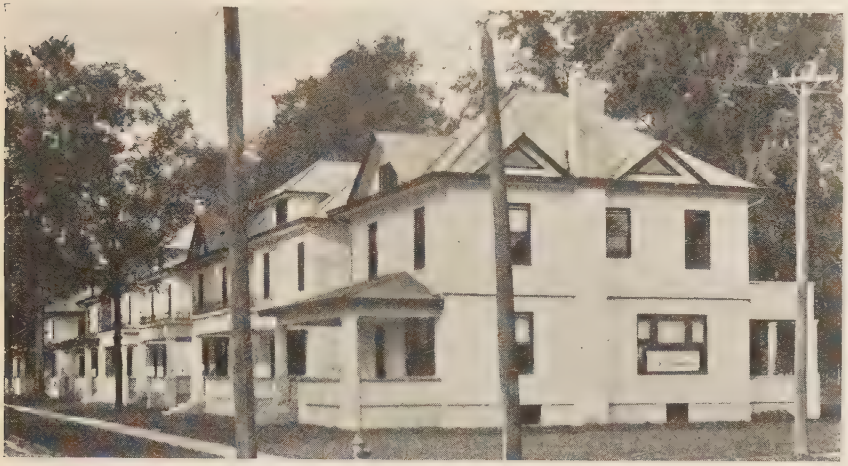

FIG. 1—A GROUP OF ATTRACTIVE POURED CONCRETE HOUSES

Following is a brief description of all-concrete dwelling houses erected by Eli Hull, at Newark, Ohio. Mr. Hull has developed an entire city square with fireproof houses. In the center he has erected a concrete community garage to conform, architecturally, with the houses. This garage, although under one roof, has a private room for each of its users.

These houses were cast in the Lambie[3] forms, one complete story at a time, including the floor and the partition walls. Window and door frames are cast in and are perfectly weather-tight.

The houses contain eight rooms and a bath and are heated by hot air furnaces, the hot air ducts being cast in the walls. The usual light-gauge metal ducts were used and they were filled with sand to keep them from collapsing. After the forms were removed this sand was allowed to run out.

Six-in. reinforced concrete walls and partitions were used from the footings to the cornice. The mix was 1 part cement and 6 parts of aggregate as it came from the river bed. The aggregate was clean, sharp sand and gravel and was so close to the necessary proportions that it was not screened, but was used as it came on the job.

The walls are reinforced with ½-in. round rods, 18″ o. c. each way. The same reinforcing was used in the floors 9″ o. c. the short way of the span and 2′ the long way. These rods also acted as tie-rods to hold the forms in place. A part of the floor reinforcing in both directions was carried through the belt course plates by ½-in. x 2-in. bolts attached to the rods by cast iron sleeve nuts. This permits leaving on the belt course plates when the wall plates are removed, and they are used as a gauge to hold the wall plates in position for the floor above, thereby holding them rigidly in place without further bracing.

The floor plates rest upon an adjustable beam, which in turn rests upon and is bolted to a ledger angle. This ledger angle fits into an L-shaped notch near the top of the plate, leaving the space below clear of braces. See Fig. 2, which also shows the second floor being cast and the method of casting the cornice without long braces. A 2-in. x 4-in. stick was cast in each belt course, both front and rear, to form a slot so that the floors of the porches could be tied to the main building. The necessary soil and gas pipes and electric conduits were cast in place.

An average time for setting up a story was less than 3 das. and not more than 7 men were employed at one time. All concrete was machine-mixed and hoisted in a tower and carried by spouts to the forms. The stories contain from 30 cu. yds. to 34 cu. yds. of concrete. It took from 5½ hrs. to 6 hrs. to pour each story. Stripping and cleaning forms took about 2 das., a total of about 1 wk. for each story. The 70-ft.

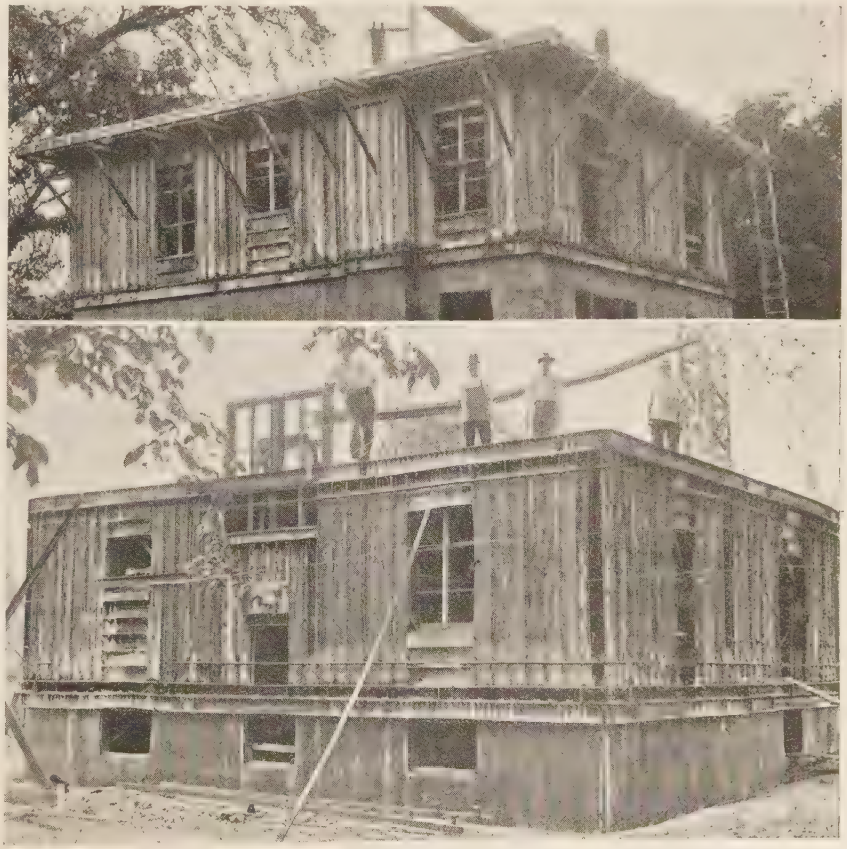

FIG. 2—FORMS IN PLACE FOR POURING FIRST AND SECOND STORY

tower was placed so that it could take care of four houses.

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[1] From CONCRETE, Jan., 1916, p. 26

[2] Chf. Engr., Lambie Steel Form Co., N. Y. C.

[3] Lambie Steel Form Co., N. Y. C.

The roof frames are of 2-in. x 6-in. spruce, nailed to a 2-in. x 6-in. plate, secured to anchor bolts cast in the cornice. The roofs are covered with different colored asbestos shingles.[4] The houses are finished with a fine stucco of white sand put on by the "Swenson" stucco machine.[5]

The interiors are finished in oak. The floors are of comb-grained pine nailed to sleepers cast in the concrete floors.

Note the difference between house No. 1 and house No. 2 after the men had become used to the handling of the forms. The writer has been informed that these houses have been completed for less than $2,500, cost including heating, plumbing and lighting. Note the cost per sq. ft. of forms in labor, also cost of concrete in place. Gravel, it must be noted, was delivered for 60 cts. per cu. yd.

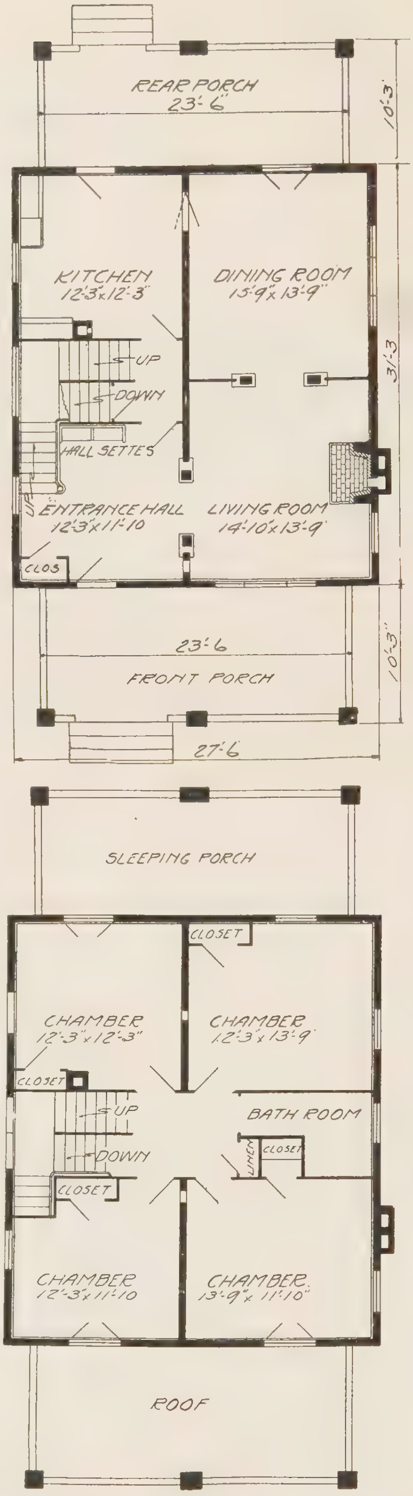

FIG. 3—FLOOR PLANS OF NEWARK HOUSES

HOUSE NO. 1, AT NEWARK, OHIO

Cartage on Forms:		
22 hrs. at 55 cts.	$ 12.10	
22 hrs. at 22½ cts.	4.95	
	$ 17.05	
Charge ⅛ of this to each house		$ 2.13
Tower (Labor only):		
54 hrs. at 45 cts.	$ 24.30	
162 hrs. at 22½ cts.	36.45	
	$ 60.75	
Charge ¼ of this to each house		$ 15.19
Excavation:		
147 cu. yds. at 19½ cts.	$ 28.67	
Footings and Cellar Floor:		
Labor: 20 hrs. at 25 cts.	$ 5.00	
Materials:		
5 bbls. of cement at $1.45 net	7.25	
12 cu. yds. of gravel at 60 cts. del.	7.20	
	$ 19.45	$ 19.45
Setting Forms for Basement 3,266 sq. ft.:		
Labor:		
126 hrs. at 22½ cts.	$ 28.35	
18 hrs. at 45 cts.	8.10	
		$ 36.45
(Cost per sq. ft. of forms in place $.0112)		
Reinforcing:		
1,420′ ½-in. round rod at 1 ct. per ft.	$ 14.20	
Labor: 7 hrs. at 22½ cts.	1.58	
		$ 15.78
Concrete—34 cu. yds.:		
50 bbls. cement at $1.45	$ 72.50	
34 cu. yds. gravel at 60 cts.	24.40	
Labor:		
18 hrs. at 45 cts.	8.10	
45 hrs. at 22½ cts.	11.13	
		$111.13
Gasoline, water and oil		1.75
(Cost per cu. yd. of concrete in place $3.34)		
Stripping and Cleaning:		
54 hrs. at 22½ cts.		$ 12.15
Recapitulation:		
Labor and materials	$177.26	
⅓ of cartage	.71	
⅓ of tower	5.06	
	$183.03	
Excavation	28.67	
Footings	19.45	
		$231.15
(Cost of concrete in basement $5.34 per cu. yd.)		

LABOR AND MATERIAL, 1ST STORY

Setting of Forms, 1st Story (3,444 sq. ft.)		
Labor:		
40 hrs. at 45 cts.	$ 18.00	
88 hrs. at 22½ cts.	19.80	
		$ 37.80
(Cost per sq. ft. $1.09)		
Reinforcing:		
1,460′ ½-in. round rods at 1 ct. per ft.	$ 14.60	
Labor:		
6 hrs. at 45 cts.	2.70	
6 hrs. at 22½ cts.	1.35	
		$ 18.65
Concrete (30 cu. yds.):		
Material:		
Cement, 44 bbls. at $1.45	$ 63.80	
Gravel, 30 cu. yds. at 60 cts.	18.00	
Labor:		
36 hrs. at 22½ cts.	8.10	
12 hrs. at 45 cts.	5.40	
		$ 95.30
Water, gasoline, oil, etc.		1.75
(Cost of 1 cu. yd. of concrete $3.23)		
Stripping and Cleaning Forms:		
Labor:		
48 hrs. at 22½ cts.	$ 10.80	
6 hrs. at 45 cts.	2.70	
		$ 13.50
		$167.00
Recapitulation:		
Labor and material, 1st story	$167.00	
⅓ of cartage	.71	
⅓ of tower	5.06	
Cost of 1st story		$172.77
(Cost of 1 cu. yd. of concrete in place $5.77)		

SECOND STORY

Setting up Forms—2nd Story 3,647 sq. ft.		
96 hrs. at 22½ cts.	$ 21.60	
72 hrs. at 45 cts.	32.40	
		$ 54.00
(Cost per sq. ft. $.0148)		
Reinforcing:		
1,538′ at 1 ct. per ft. (½-in. rod)	$ 15.38	
16 hrs. at 30 cts.	4.80	
		$ 20.18
Concrete—38 cu. yds.:		
56 bbls. cement at $1.45	$ 81.20	
38 cu. yds. gravel at 60 cts.	22.80	
Labor:		
28 hrs. at 22½ cts.	6.31	
21 hrs. at 45 cts.	9.45	
		$119.76
(Cost per cu. yd. $3.15)		
Removing Forms:		
96 hrs. at 22½ cts.		$ 21.60
Recapitulation:		
Labor and material, second story	$215.54	
⅓ cartage	.71	
⅓ tower	5.06	
		$221.31
(Cost per cu. yd. in place $5.81)		

TOTAL CONCRETE COSTS:

Cost of concrete work	$625.23
Window frames	60.00
Electric conduits and boxes	20.00
Flues	4.00
Soil pipe	4.00
Sleeve nuts	9.00
Incidentals	6.00
	$728.23

(102 cu. yds. in building.)

NOTE 1—This does not include charge for investment in forms or overhead.

NOTE 2—House No. 2 cost, at the same point, $684.65, a saving of $43.58, due to experience with the forms.

Stopping Leaks in Concrete Walls

Frank Noren, Carpenteria, Cal., contributes the following suggestion for stopping local leaks on concrete walls:

Clean out the hole or crack and cut it large enough to calk easily. Soak newspaper and sprinkle with dry cement 1/16″ thick on both sides. Crimple into a ball and plug the hole tightly. If the force of the water softens the mass too fast force in more dry cement and hold tightly in plce. It may be necessary to try several times but this trick can generally be done.

The use of building paper in lining forms needs constant attention in order to secure satisfactory results. The paper is easily torn in placing reinforcement and in shifting the forms, requiring much patching. It is also somewhat difficult to keep the paper absolutely smooth so that the final surface does not show any wrinkles.

Carpenters should not be allowed to do sawing over finished forms after reinforcing is placed.

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[5] Swenson Automatic Stucco Mach. Co., N. Y. C.

[4] Keasbey & Mattison Co., Ambler, Pa.

Houses at Forest Hills Gardens, Long Island[1]

By Frederick Squires

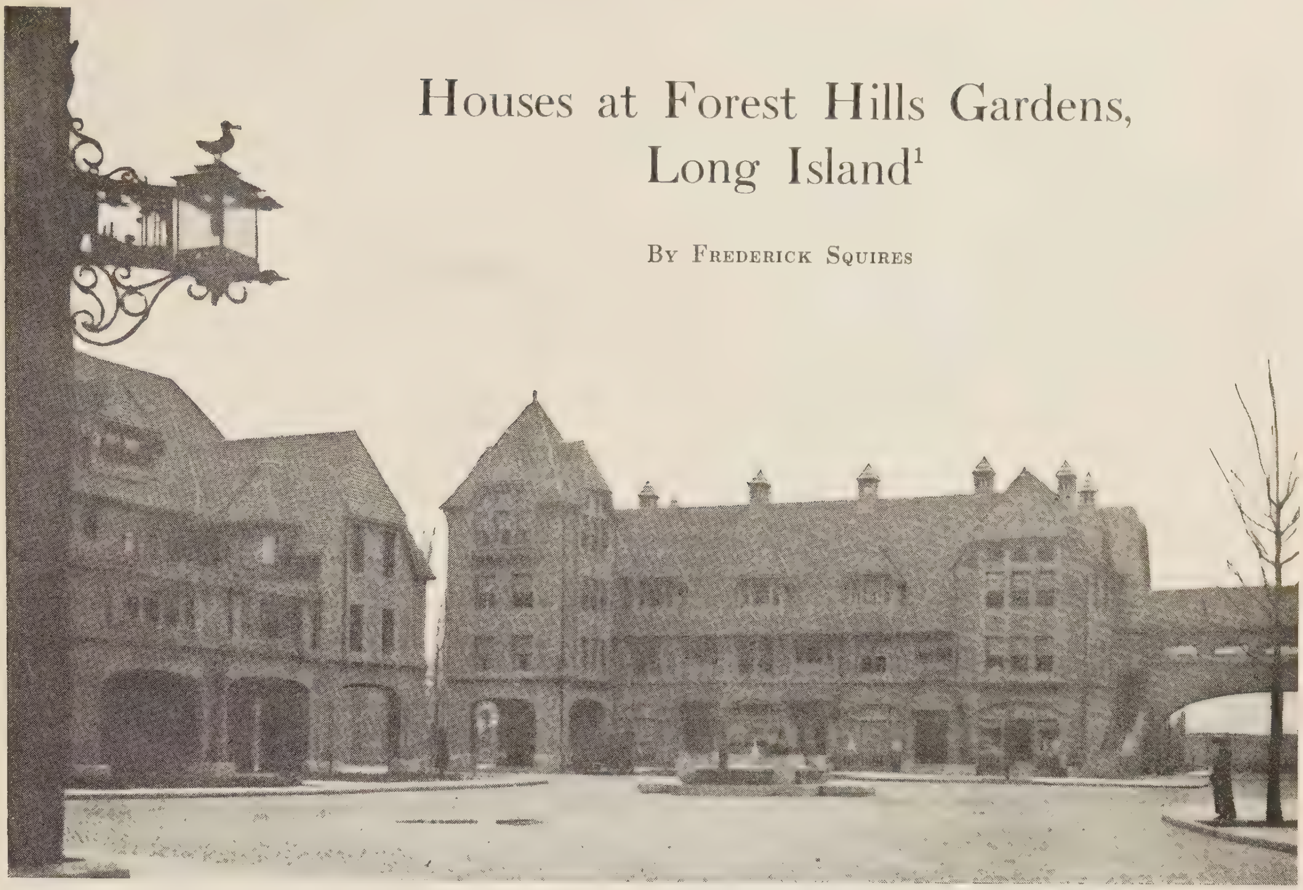

Fig. 3—Plaza at Business Center of Forest Hills Gardens, Long Island

A house of pre-cast concrete block is no new thing, in fact, concrete was first of all used for residences in the form of small pre-cast block to be set by hand. The size of the building unit has usually been predetermined by some peculiarity of its manufacture, brick, for example, being small because only small pieces of clay can be burned successfully. In other cases where there is no such limitation in manufacture, the size is made convenient for handling both while being made and while being used, as in the case of hollow tile, stone and wood. This is the only reason for the size or rather the weight of the average concrete block, one of whose dimensions is in most cases a wall thickness. Steel is so heavy in proportion to its size that almost all its structural sizes are too heavy to be handled without the use of machinery, but for all high structures its obvious advantages far outweighed this handicap. Grosvenor Atterbury, in the development of Forest Hills Gardens for the Sage Foundation, has applied the methods of handling steel to pre-cast concrete block for certain of the dwellings.

As monolithic concrete construction advanced, it became increasingly customary to pre-cast certain of the structural parts, beams at first, but finally even columns and slabs, although often the slabs were poured in place after erecting the frame work. Ernest Ransome perfected this method for commercial work, and meanwhile Mr. Atterbury, a New York architect, was conducting scientific experiments looking to the use of large pre-cast concrete slabs for floors and walls of dwelling houses.

These studies began about 10 yrs. ago, and for the last 5 yrs. or 6 yrs. the experiments and demonstrations have been conducted under

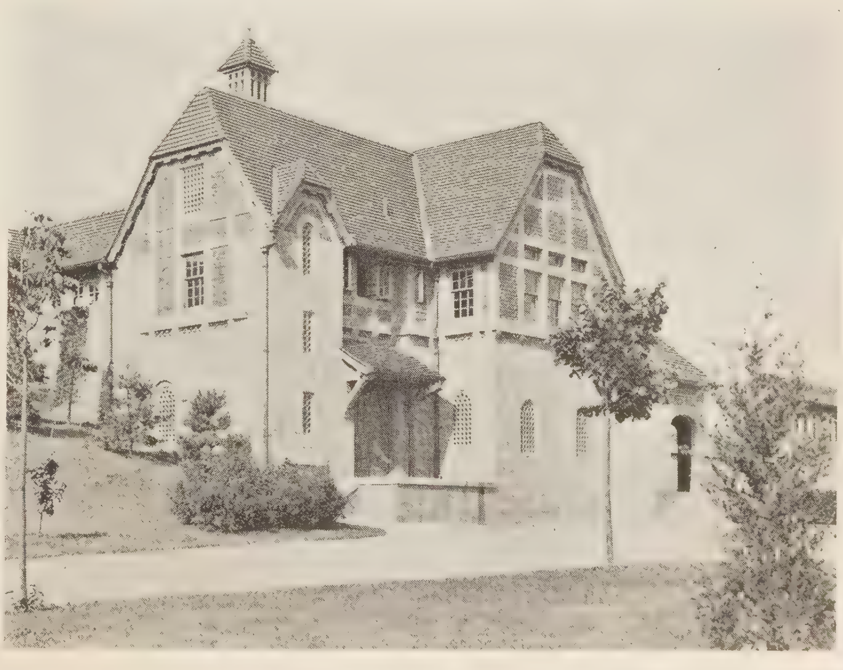

Fig. 4—View of Railroad Station, Showing Pre-cast Concrete Grilles, Brushed Concrete Stucco Walls, and Half Timber Applied in Situ Over Terra Cotta

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[1] From Concrete, Jan., 1915, p. 3. For a statement of the original program of Grosvenor Atterbury, architect for the Sage Foundation, see *Cement Age*, Dec., 1910, p. 315.

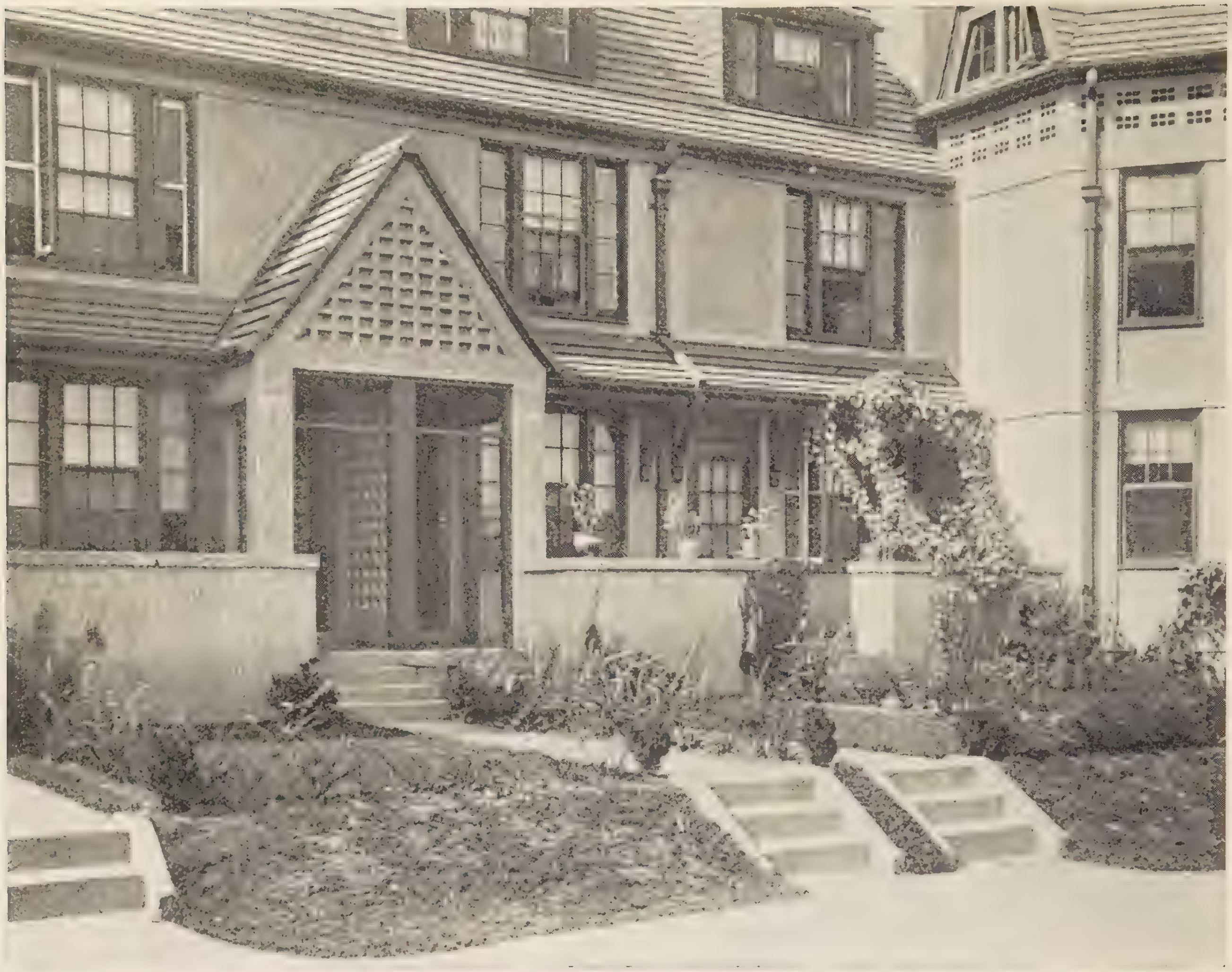

Fig. 1—Detail of Concrete House in Group 2, Erected for the Sage Foundation Homes Co. Under Mr. Atterbury's System of Hollow Sectional Concrete Construction

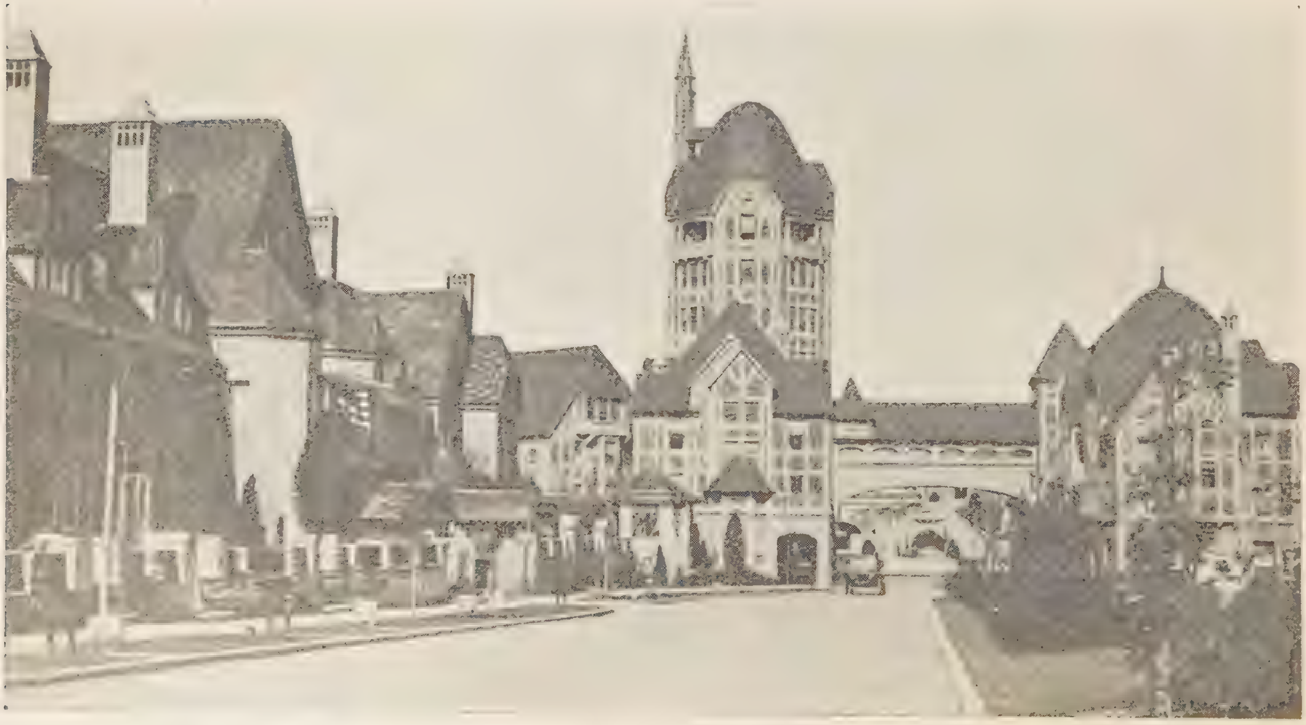

Fig. 2—View of Tower and Business Center at Forest Hills Gardens

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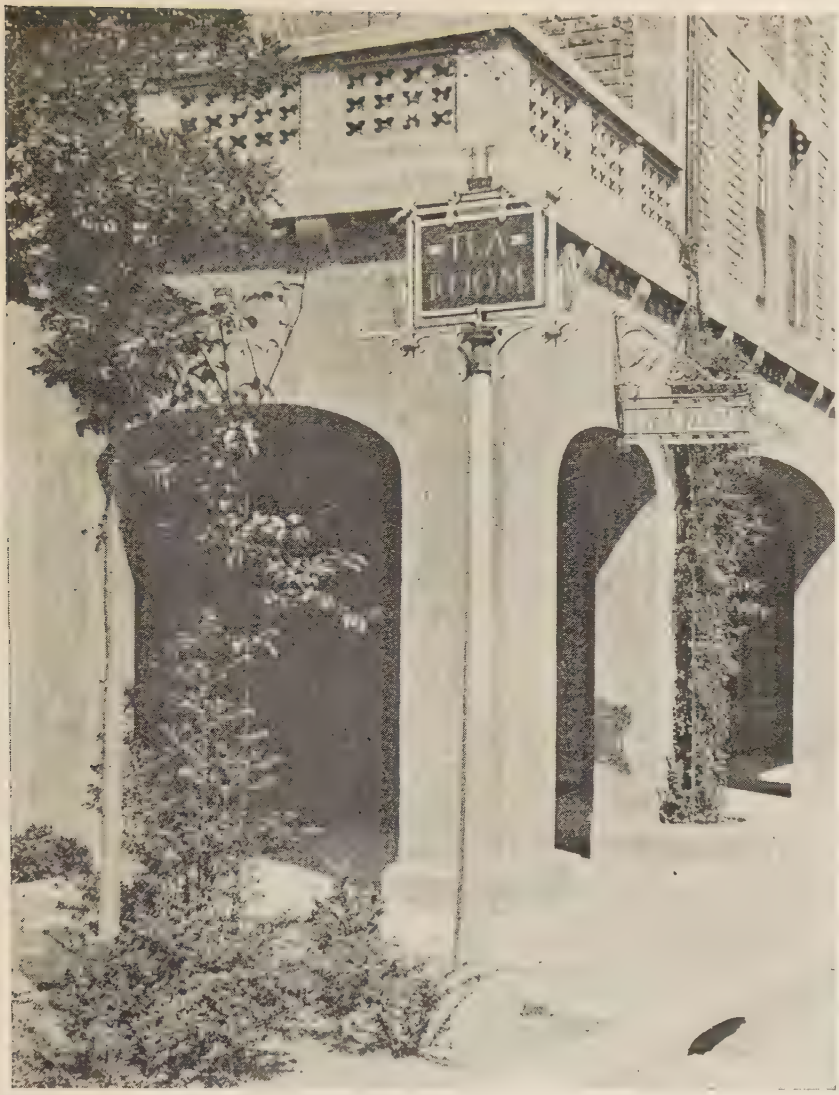


Fig. 5—Detail Showing Texture of Brushed Concrete Work Applied in Situ with Colored Aggregate

an aggregate of broken roof tile, which corresponds pleasantly in color, with the red tile roofs. The pierced designs of the chimney tops and the exquisite texture of the concrete fleche finishing the tower are particularly worthy of attention. Nowhere is the trademark of good taste more clearly printed than in such uses of a much misused material. The views of this quadrangle show, in the sidewalk arcades, how easily overhanging stories may be accomplished in concrete construction. Passing through the courtyard and looking back on it from the main road, there is a scene for picturesqueness not equaled anywhere in America and for an artistic use of concrete unequalled in the world. Pierced chimney tops, beautifully toned stucco, concrete paneled walls, fountains, telephone poles, balustrades, tea-houses, ramps, fleches, balconies, all executed with wonderful charm in a material for which a great English architect studiously denied the possibility of artistic expression. For years in N. Y. C. Italian and Greek ornamental plaster makers have been casting lovely concrete images and engineers have been designing concrete buildings. Mr. Atterbury has brought the two together.

Much of the beauty of the group cannot be shown in the illustrations, the colors of the exposed gravel aggregates and the crushed red tile playing an important part in the

appropriations made by the Russell Sage Foundation. As the result of this work Mr. Atterbury has developed a system of building construction whereby mechanical devices have made practicable the use of pre-cast concrete block many times larger than the old concrete hand unit.

It may be worth while first to get a broader view of the interesting place of which this group of pre-cast slab houses forms a part. The very introduction to the place, the railroad station, usually the most distressing feature of any American town, is at Forest Hills a place of excellent design, stucco covered and largely built of concrete. Seen from its platform is a picturesque new-old quadrangle, all the buildings forming it tied into an unique composition by bridges, and its interest magnetized by a tower, a structure steel framed but floored with concrete.

These buildings are concrete paneled, with fields of brick work; the tone of the concrete is obtained with

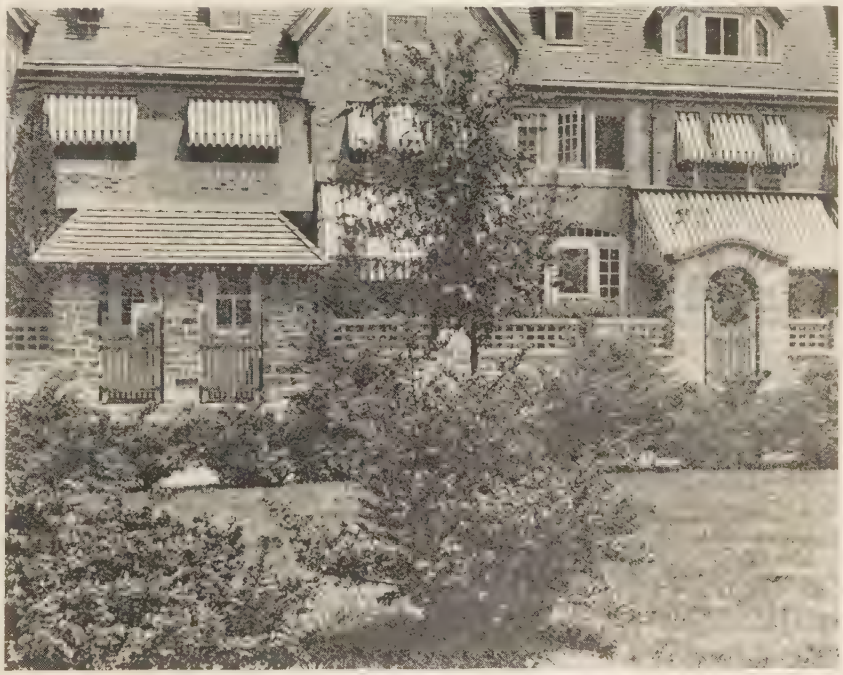


Fig. 6—Portion of Group 6, Forest Hills Gardens, L. I.

Shows in upper stories concrete half-timber work composed of pre-cast hollow sections made in the factory, reinforced and filled in erection; terra cotta block and brick panels inserted, also brushed concrete grilles, copings on terrace walls, and gateways

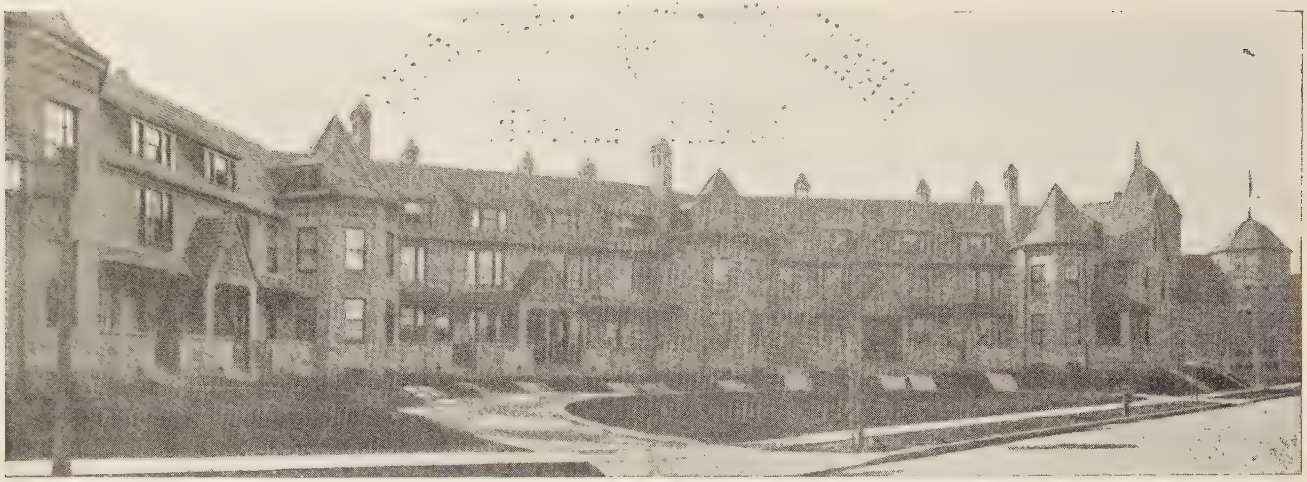


FIG. 7—GROUP 2, FOREST HILLS GARDENS, L. I.

Of this group the 10 small houses were erected under Mr. Atterbury's system of hollow sectional concrete construction, the four larger ones being composite in type, with roofs, floors and partitions of various fireproof methods of construction

general effectiveness. There is a warmth of hue which has been attained only occasionally in concrete work. The reproductions from photographs do show texture, however. Even the concrete sidewalks are obviously not "cement sidewalks," as the aggregates have been exposed.

While the general appearance of the main groups is similar, in that almost all of the exterior walls are paneled with concrete bands or half timber, which represent the horizontal and the vertical reinforcements in the walls, they are in some cases formed in the ordinary way by using terra cotta block reinforced and covered with concrete stucco on the exterior, the intermediate spaces being filled in with a veneer of brick; while in other cases it is a true reinforced concrete skeleton building in which panels are formed by the erection of pre-cast tubular concrete timbers reinforced and filled after erection at the building. This method of construction—the employment of what may be called permanent molds—is the intermediate step between the ordinary *in situ* process of concrete construction and the factory-made sectional system illustrated in the figures of the group of 14 houses erected and now occupied for something over a year at Forest Hills Gardens.

It will be best to preface the description of this group of pre-cast houses with a visit to the factory where the units are made. From the casting shed or head house an overhead electric crane runs out through the storage yard, where wall, floor and other sections are stacked ready for transportation on small cars running over an industrial railroad to the building site.

The entire process—manufacture, transportation and erection—involves only three necessary handlings of the units. After being poured from the mixer into the steel molds and partially hardened, the sections are lifted out on false bottoms by the electric crane and finished while still green; as soon as they are hardened they are lifted off the false bottoms and placed on the transportation cars in the storage yard, to be handled for the third and last time when they are picked off the cars and set in their proper places in the building by the erecting crane.

The actual time during which labor is put upon these sections, from the gravel bin to their completion in the building, amounts to less than 5 hrs. The minimum time for seasoning, during which no labor is put upon the block, is approximately 3 das. for the wall units and 1 wk. for the floor sections. Replacements were actually made and set in the buildings within 3 das. at Forest Hills and 20-ft. floor sections have been handled 1 wk. after casting. A longer time, normally, should, of

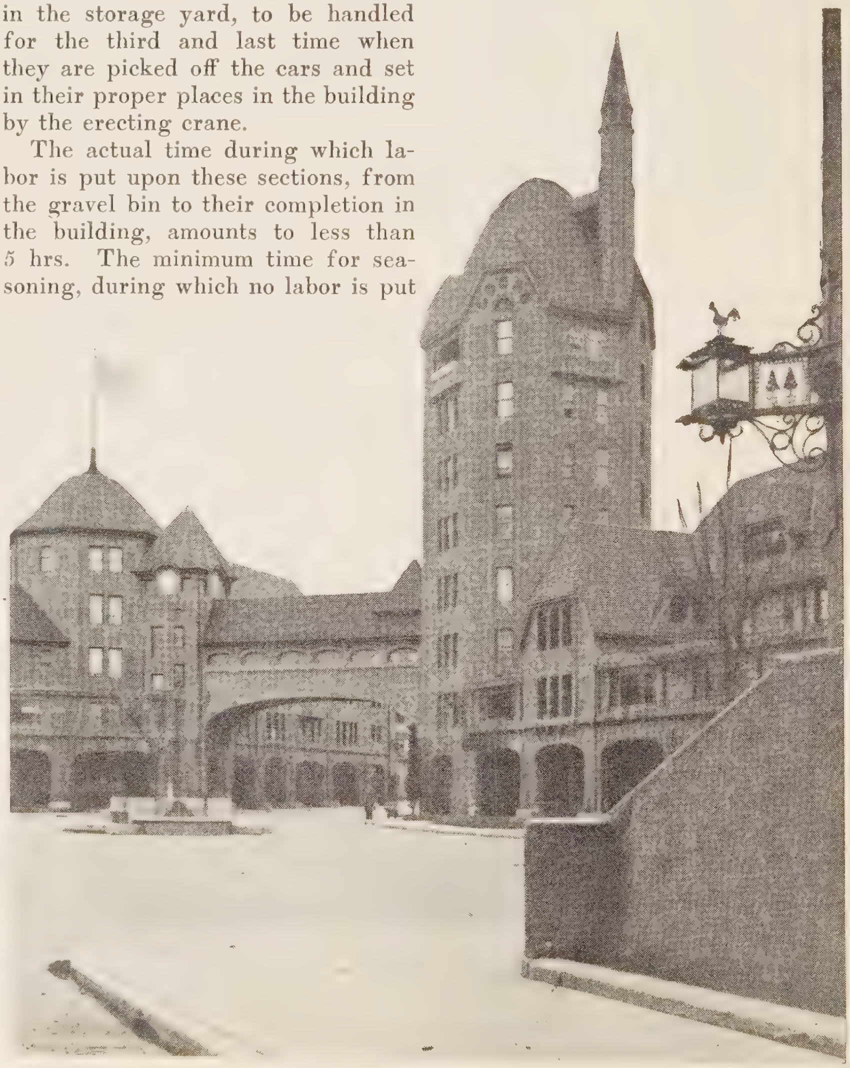


FIG. 8—DETAIL OF THE TOWN CENTER, WITH TOWER AND ARCHED STREET

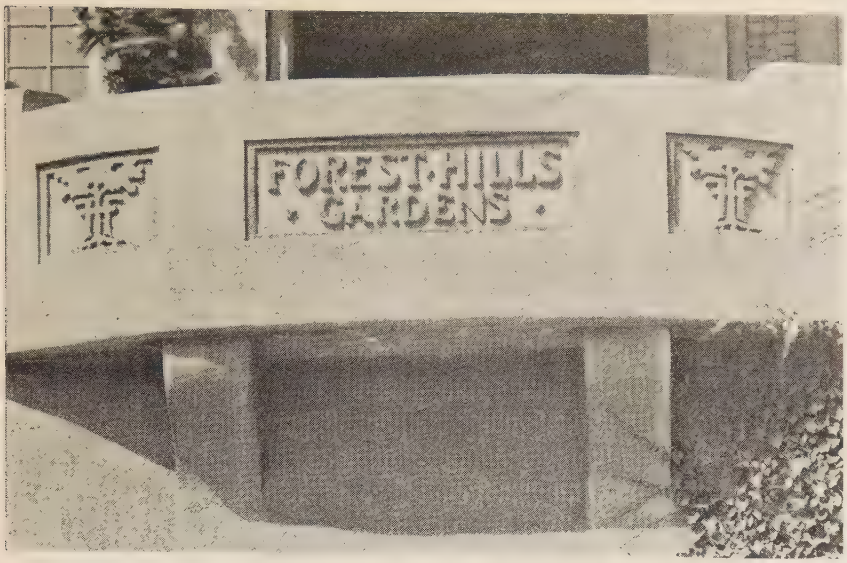


Fig. 9—Balcony, Showing Use of Pre-cast Decorative Brushed Concrete Panels of Colored Aggregate and Colored Concrete Mosaic Backgrounds

course, be allowed for manufacturing and seasoning. But with a proper plant and good conditions the erection work can begin within 2 wks. after the commencement of manufacture. This includes the time necessary to finish completely both the exterior and the interior of the wall sections, for the system contemplates the omission of lath, plaster and interior trim, the section being molded on the interior side so as to form panels in the walls of the rooms.

The process of erection is designed so as to eliminate as much as possible the scaffolds, temporary supports and the waste time consequent upon the ordinary construction, where one trade follows another and is more or less dependent upon prompt cooperation.

In this operation the time occupied in lifting the block from the transportation car and placing it in position in the building, trued up and wedged ready for grouting, averaged about 20 min. for each section. As a matter of fact, owing to the shape of the group, it was impossible to keep the crane busy, since the greatest number of houses erected at one time was five. On a straight group where the crane could move readily up and down the track, without having to be turned, the speed of erection could undoubtedly be doubled. Even under the existing conditions the records show that in the first operation, covering three small houses, the concrete shells were completed and ready for the finishing trades—plumbing, heating and painting—in 6 wks. from the laying of the foundations. This was at the rate of a house in 2 wks., and was accomplished by laborers who, with only one exception, had never before seen the system in operation.

The second group of four 13-ft. houses was erected in 5 wks., or at the rate of a house in 9 das.

As the curing process occurs in the factory before beginning erection, the speed of erection and completion under this system can be pushed to its economic limit. It is evident from the records of the demonstration at Forest Hill Gardens that sectional houses in groups can be erected at the rate of one a week and completed by the finishing trades, ready for occupancy, in 2 mos. from the first delivery of sections at the site. In the buildings at Forest Hills, which had to be finished to correspond with the high class structures adjacent to them, 7 wks. or 8 wks. were spent in finishing and decorating the interiors.

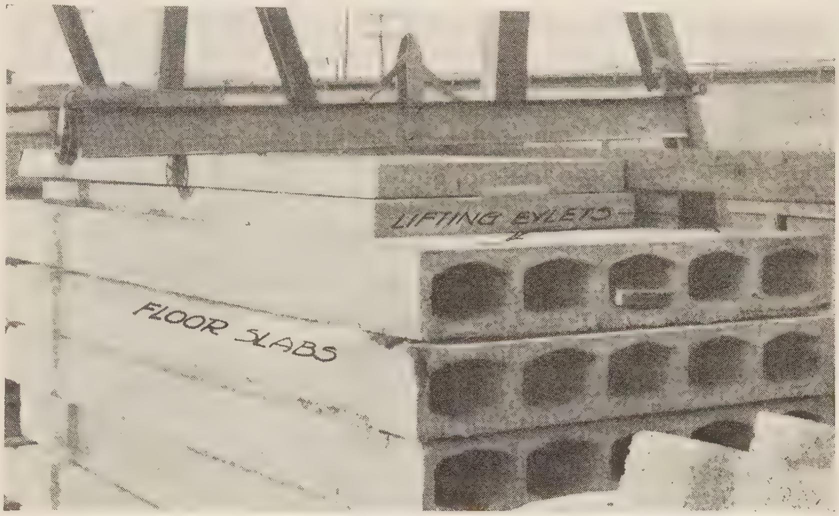


Fig. 10—Floor Slabs in Storage Yard of Factory

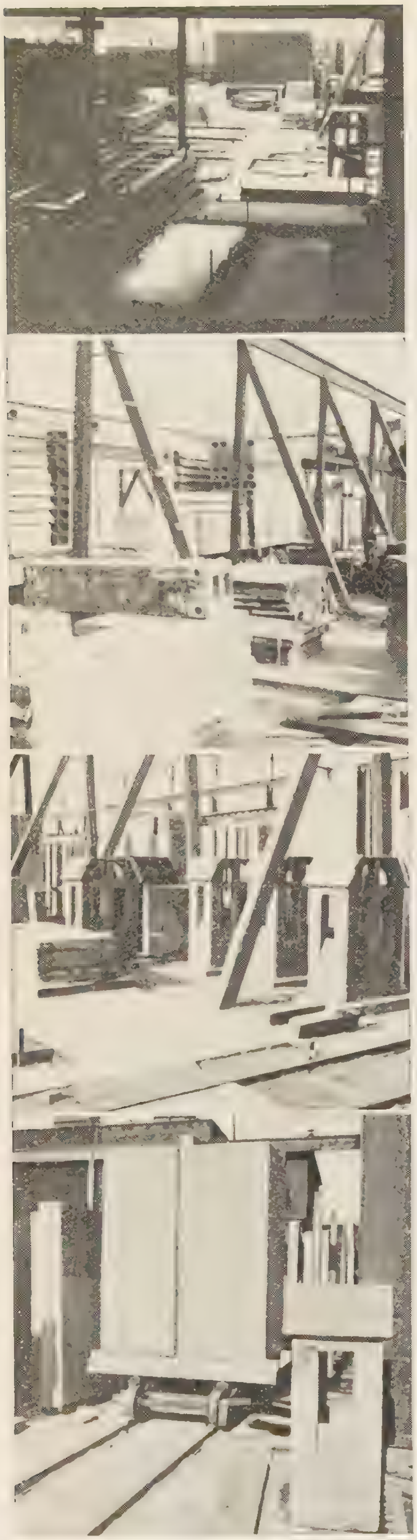
While in a majority of the houses the interior surfaces of the walls are all of concrete, as before explained, certain of the houses are plastered directly on the wall sections and have floors constructed of pre-cast concrete beams. These concrete beams had on top and bottom a surfacing of a cementitious nailing mixture into which floors and lathing were nailed. The same product of the factory was used on the roofs as a nailing surface to receive the tile.

Among other by-products of the demonstration work at the factory there has also been developed a hollow wet process concrete block, with a brushed surface of ordinary hand unit size, for use in buildings not permitting the introduction of the large and undoubtedly more economic standard sections.

While the factory has thus been used for all the various products employed at Forest Hills Gardens, the plant, as was to be expected, has not justified itself commercially through the products utilized so far in the buildings erected with pre-cast units.

So much of the work done has been pioneering, with such large expenditures to be made and remade in various undertakings which were purely experimental, that Mr. Atterbury's achievements in the Sage Foundation undertaking are more a contribution to the science of building with pre-cast units than a successful investment in the immediate work described. Mr. Atterbury believes that in spite of adverse conditions the commercial possibility has been demonstrated, so as to be available in further undertakings which are of sufficient magnitude to warrant the "wholesale" methods involved.

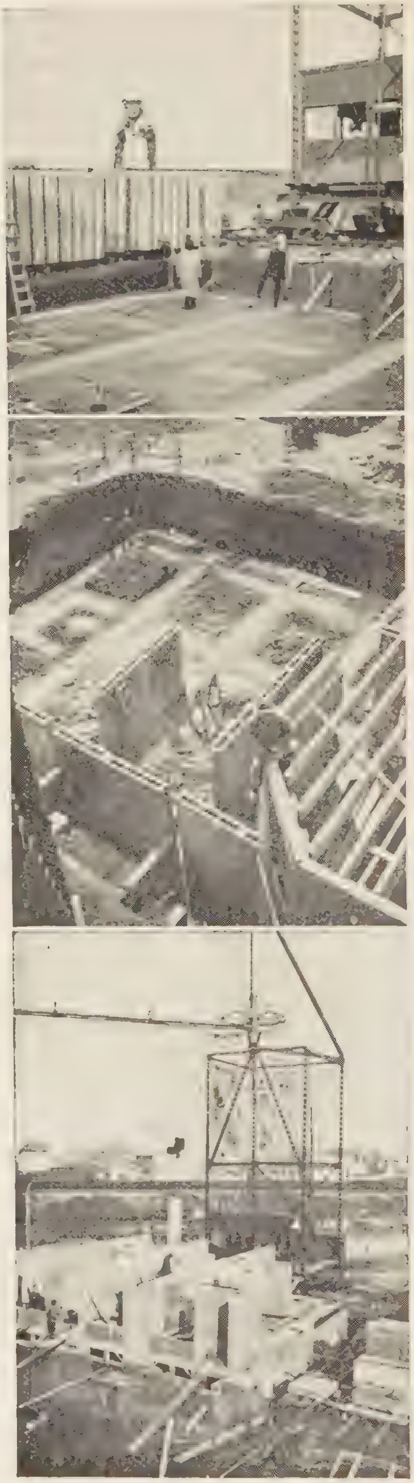
One of the preliminary decisions arrived at in connection with the manufacture and use of large wall



Figs. 11, 12, 13 and 14—Views at Factory for Pre-cast Units at Forest Hills

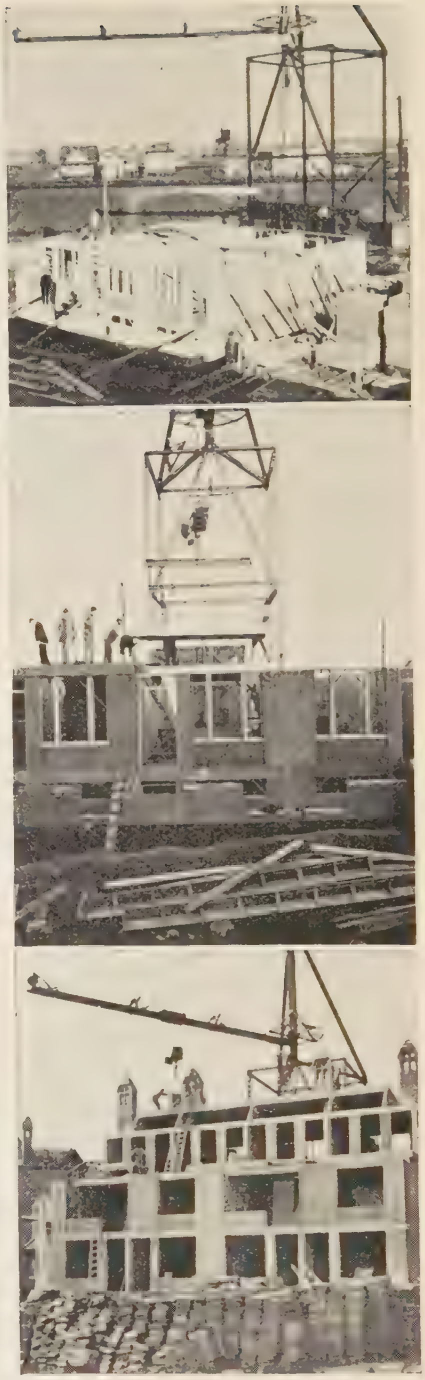
(13) Floor slabs in molds in foreground; yard in background; (14) units piled in yard; (15) chimney caps in yard; (16) wall slabs on cars for transportation to building site

and floor units was this: In order to make it practicable to adopt a really scientific and economic design, all units were to be cast and subsequently handled in the same position as that in which they were to be put under stress in the building itself.



Figs. 15, 16 and 17—Successive Views of Building Operations with Crane Placing Units

The floor units were thus made horizontally and the wall units were cast vertically. The molds for the wall units were in a pit and were faced by the use of a dividing plate with the special facing mixture on one side, backed up on the other with the regular mixture. This in all cases was poured wet. The molds are of steel, the sides hinged at the bottom and adjustable for different thicknesses of slab. Both floor and wall molds were equipped with collapsible



Figs. 18, 19 and 20—Detail Views of Pre-cast Unit Houses Under Construction

or tapered cores, which were steam heated for rapid curing of the wet mix. By this method it was found actually possible to remove a one-ton wall slab vertically from the molds in 2 hrs. after pouring, but this was obviously undesirable, as the great heat required "cooked" the concrete so as to deprive it of much of its strength. In practice each mold was never used more than twice in 24 hrs. Floor slabs were usually 14′ long, 5′ wide and 10″ thick. Wall slabs were usually 8′ 6″ high, 6′ wide and 9″ thick, cored and having 2¾-in. webs and outer and inner shells 1½″ thick.

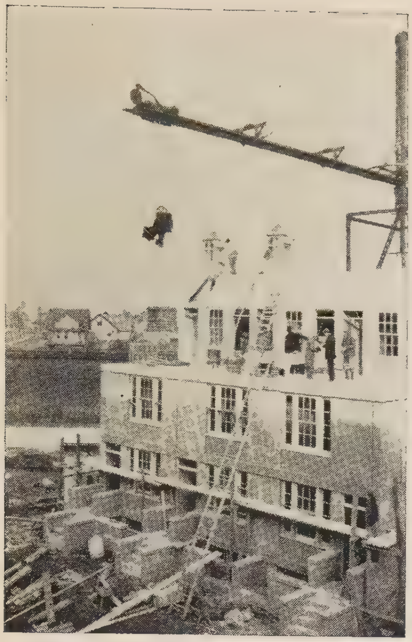


Fig. 21

In the earlier demonstrations the average wall sections weighed a little less than 1 ton, being the equivalent of from 1,200 to 1,500 brick laid in an 8-in. wall. Experiments, however, showed that still greater economy could be effected by increasing the size of the units, which now run from 1 ton to 3 tons in weight, the practical limitation imposed on their size really lying in the design of the structure itself and not in any mechanical difficulty of manufacture, transportation or erection.

Floor slabs weighing 3½ tons, 11″ thick, 6′ wide and 20′ long have been successfully handled and tested; although in the 14 houses recently erected at Forest Hills Gardens the houses did not require floor sections more than 14′ in span. Obviously, the success of this idea from a mechanical point of view depended upon the substitution of high power machinery for ordinary hand labor, the key to the situation being an electric crane and derrick.

Surfaces for the interior walls of the houses were brushed over with grout after removal from molds, to fill all pores and pin holes and were then rubbed down to a smooth finish and subsequently decorated. Exterior surfaces in some cases with special facing mixtures, and sometimes with ordinary gravel mix, were scrubbed a few hours after casting —the exact time being governed by weather conditions. This scrubbing was done with stiff fibre or wire brushes at a cost of 1 ct. per sq. ft. Power brushing machines were tried but discarded. At the age usually of 2 das. the scrubbed surfaces were acid washed, to brighten the aggregates.

Floor and wall slabs have nailing strips, for securing wood floors and metal eyelets for attaching the derrick chain hooks. The under sides of the floor slabs were cast smooth to be exposed, but they were finished with heavily stippled paint, after erection when the interiors were finished and decorated. The cores are vertical in the walls and the lifting device for handling them operates through them so as to lift the sections from the bottom. There are two patterns of wall block in each story, a slab the full clear story height and a short panel from floor to window sill. Each slab, except for corner use, is tongued on one closed side and grooved on the other.

In the regular 13-ft. houses, which were the only ones of really standardized construction, each house, including its terraces and walls, contained approximately 140 sections of all kinds, the total in the entire group of 14 houses approximating 2,000; all of these were manufactured, transported and erected with an astonishingly small loss by breakage.

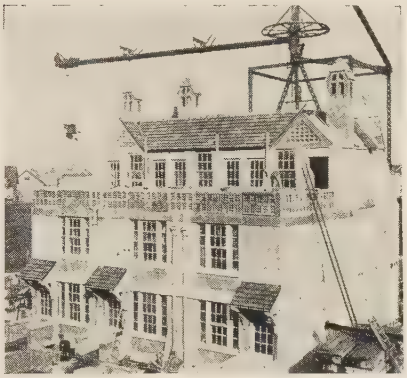


Fig. 22

Building operations, in this particular case, were on a cleverly planned crescent-shaped group of attached houses.

The electric derrick, which is moved to and from the building operation on the same industrial rails used for the transportation of units, can be moved by means of its own power or, as was the case after completion of this group, hauled by an ordinary heavy steam roller. This crane has a lifting capacity of 5 tons with a swing of 270°, a 40-ft. hoist and a 40-ft. clear reach, so that it could put the chimney tops on this group of houses, substantially equivalent to three stories in height. It is obvious that such an equipment and layout are too elaborate for economy in any but large operations, the derrick alone costing $7,000 or $8,000.

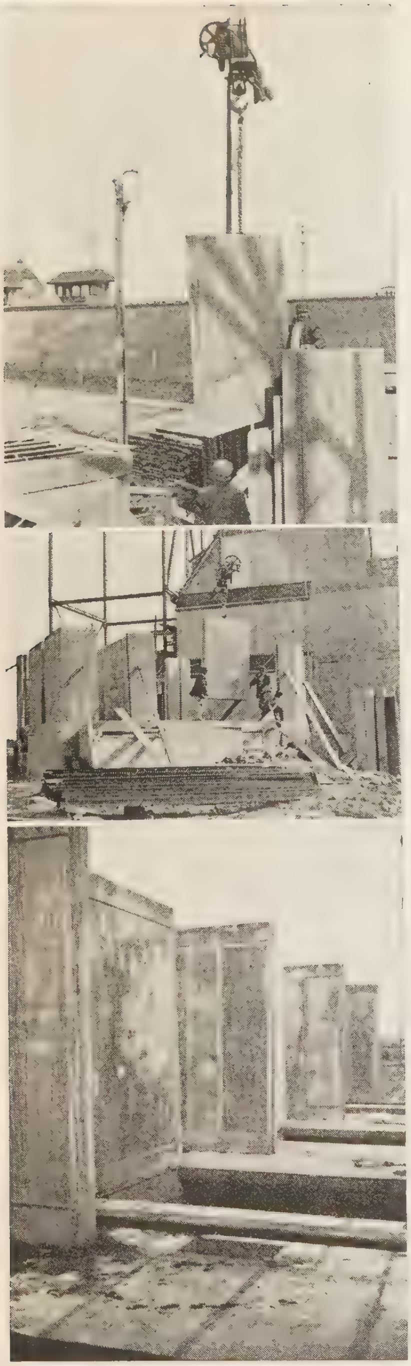
The subsequent illustrations of the process of erection need very little further explanation.

The electric crane, operating above the storage yards, lifted the foundation block onto cars which followed the tracks laid down for the derrick, and were relieved by it of their burden, which was swung into place on the footings already prepared. When all the foundation walls were in place they were bedded solidly upon their footings by grouting from on top through the core holes and by this method also the tongue- and-groove joint was made perfect. In this group all joints were later coated from the outside with oakum and pointed up over it.

In the original experimental house erected the floor and wall sections contain rabbets, so as to give a mechanical obstruction to leakage from the outside. This was entirely satisfactory; and in the second house an experiment of omitting this mechanical lock was tried in order still further to economize in the cost of manufacture. For more than a year there was no trouble, even under these conditions, and in view of that experience the same design was adopted for the group at Forest Hills Gardens. Later on, however, trouble was experienced with these straight joints; and as it was too late to modify the design the caulking process was resorted to in order to avoid any trouble of this nature. Obviously in future opreations the rabbet will again be introduced, experience having shown that the only vulnerable point is the joints, and almost entirely in the horizontal ones. In no case has experience shown that dampness has made its way through properly cast hollow wall sections of the design here illustrated.

In placing the units, the crane actually handled 2,000 cu. ft. in a day, not working by any means to its full capacity but handling all the units which could be placed and grouted by eight men. Two of these men attended to placing and six to grouting.

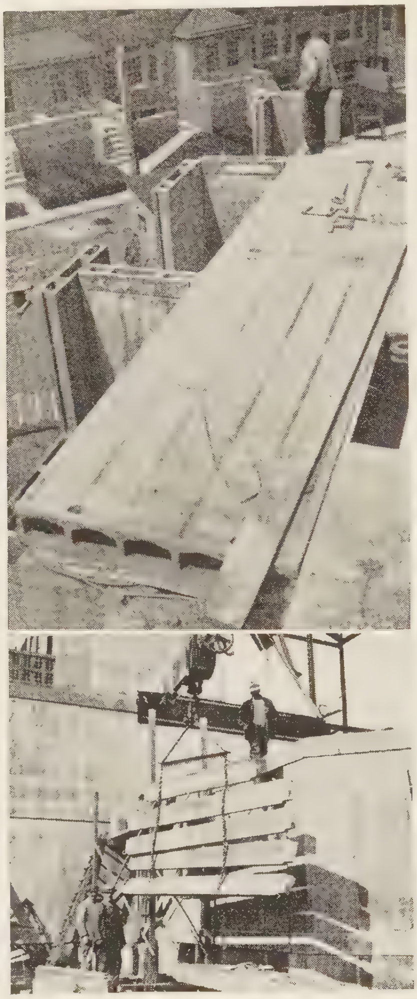
When the basement tier of wall sections had been set and grouted the floor slabs were in turn hooked up by the four corners and laid in their proper positions on the basement slabs and similarly grouted in place. The outermost floor slabs show through the wall, project over it a little and are provided with a wash and drip. The exposed surface was usually arranged to be a closed side, but when the naturally cored end of the slab was exposed it was plugged



Figs. 23, 24 and 25—Wall Slabs Being Set in Place—Note Paneled Inner Surface in Fig. 27

and finished like a side adjoining floor slabs and its ends and sides were anchored together with iron straps let in and grouted. Abutting ends were grouted together and for this purpose thin sheet metal caps were placed over the upper ends of the wall slabs which carried them so as to hold the grout. Upper walls and floors were similarly constructed.

Wall slabs adjoining an opening have a groove toward it into which were slipped wooden window and door frames. It will be noted that every floor shows through and that every feature of construction writes itself on the outside of the building so that he who runs may read. This is the gospel of architecture and it has scarcely ever been so closely attained in anything but a concrete building.



Figs. 26 and 27—Above is Shown Floor Construction with Hollow Slabs; Below Floor Construction with Pre-cast Beams, the Beams Being Hoisted Into Place

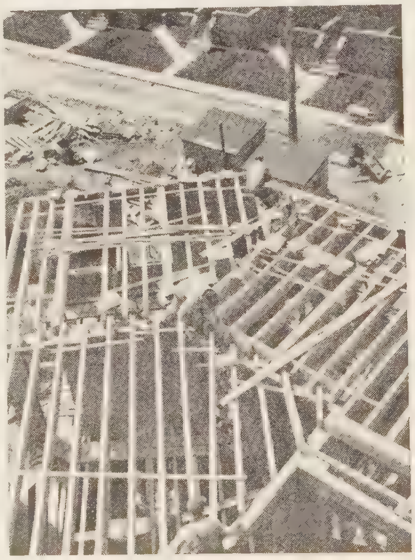


Fig. 28—Pre-cast Floor Beams in Place

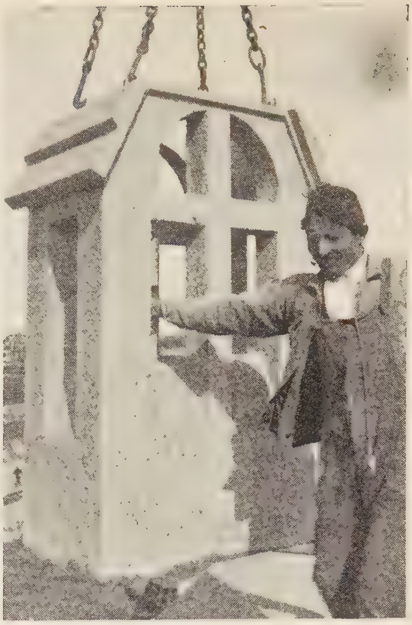


Fig. 29—Ornamental Chimney Top Being Lifted Into Place

Pre-casting concrete slabs insures scientifically placed reinforcement, uniform setting and sufficient curing. It is attended by none of the difficulties of adverse weather conditions, untrueness of forms and unpreparedness for load carrying which are the nightmares of the monolith. It makes possible the use of casting machinery and standard molds, so as to avoid all wastage of all kinds incident to ordinary casting work *in situ;* it permits, as well, a reduction of the factor of safety to a more scientific point both in materials and design; it offers opportunity for all the economies incident to factory conditions.

Quite apart from its economic aspects, its stability and its fireproofness—properties common of course to all properly built concrete structures, it is evident from the demonstration described that there is a further distinct advantage in the important saving in time accomplished under any system which manufactures a house substantially in the factory instead of on the scaffold, as has been the ordinary custom. Up to the present Mr. Atterbury's system of standardized hollow sectional construction requires a plant incompatible with economy in small operations, but the same might once have been said about erecting structural steel.

To an architect the most satisfying thing about this crescent of concrete dwellings, set in sharp competition as to appearance with some of the best small suburban houses in America, is that the group holds its own in color, texture and design in spite of the fact that it is composed of "standard" sections made out of ordinary sand, gravel and cement.

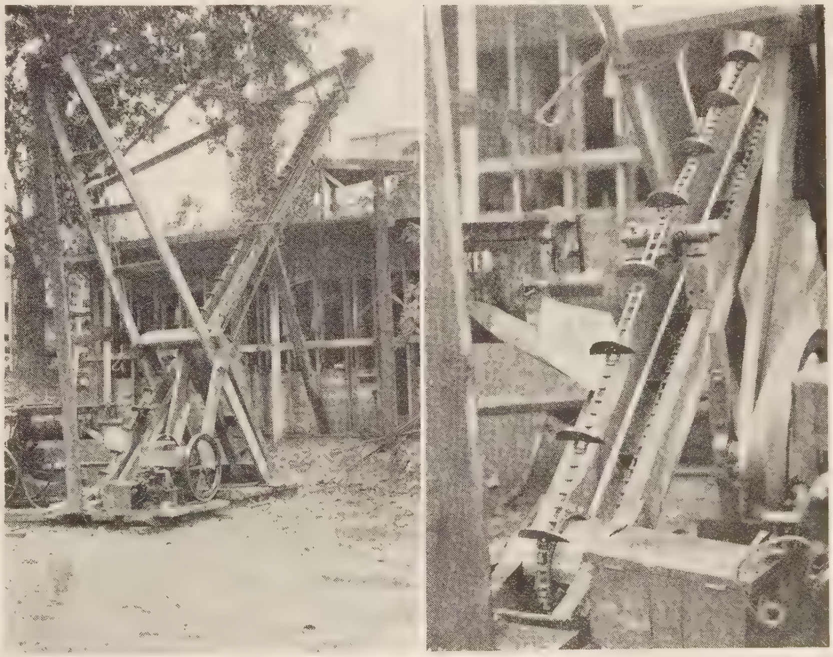
Building Low Cost Houses With Unit Forms and Continuous Conveyor[1]

Low costs are being obtained by the Humphrey Co., Cleveland, in the construction of small concrete cottages at Euclid Beach Park, using a new commercial system of forms consisting of plates and ribs[2] and for placing the concrete a continuous mixer[3] with elevating equipment designed by D. S. Humphrey. The work has been in charge of P. M. Killaly, engineer for the Humphrey Co. The initial undertaking in this construction of concrete cottages was described in CONCRETE more than a year ago.[4] In the first work a system of wood forms was used which, it was found, required too much time in erecting. Further work has been waiting in the meantime for the perfection of the commercial system of forms which is now in use and which probably will be used in the construction of many other cottages if the work continues as satisfactorily as it is now believed it will.

The two cottages recently built are 35′ x 22′ outside dimensions and 9′ high from floor to ceiling. They are for summer campers and will replace tents which the Humphrey Co. has rented for various short periods of time in the summer at Euclid Beach. Canvas tents were found very expensive, as they lasted in good condition only two or three seasons and the construction of concrete cottages along some rather original lines was undertaken with the idea of finding something which would be more economical in the long run. The cottages have three rooms, including a fairly large living room, kitchen and bath room, with hot and cold water and a porch extending around three sides of the house, which is to be screened off and used probably for the most part for sleeping accommodations. The plan dimensions include the porch. No attempt has been made to build these houses for all year around occupancy.

The walls are 4″ thick, the slabs for the floor and the roof are 5″ thick. The roof is surmounted by a low parapet all around and the roof slab covered over with 6″ or 8″ of soil, on which grass will be grown. The idea of this soil and sod covering is to prevent the rooms below from becoming too hot under the summer sun. The floors are laid directly on the ground, being constructed first, and the forms set up on top of them. The soil is well drained and sandy along the water front and it is believed that for the purposes intended this method of construction will prove entirely satisfactory. Each of these cottages as now built requires 54 cu. yds. of concrete. Lake gravel is used, screened through a 1⅛-in. screen, with a mixture of cement in the proportion of 1 part cement to about 3½ parts or 4 parts of the gravel. The gravel costs nothing except hauling and this cost for each cottage does not exceed $20. One house requires 77 bbls. of Portland cement, at a total cost of $99. It took eight men a little over 4 das. to erect the forms, but the foreman of the job is confident that when these form sare entirely perfected, as they had not been in the construction of these houses, it will be possible, through greater ease in fitting the plates and the ribs, to set up the forms in about half the time that it required on the first two cottages. This would bring the cost of setting up the forms to $34.40, the men being paid at the rate of 24 cts. per hr., with the exception of two men, who were paid 25 cts. per hr. No skilled labor was required. The continuous mixer driven by a Novo[5] engine is used and the concrete is mixed very wet. It falls direct from the mixer trough into the elevator, which is shown in the accompanying illustration.

As has previously been described, this elevator for the concrete consists merely of paddles on a chain operating in a trough. This chain is run at high speed so that whatever concrete slips through one paddle is picked up by the next one. The rapidity of operation makes it possible to convey even a pail of water from the bottom of the conveyor to the top of the house. The framework supporting this conveyor and the conveyor itself have been enlarged somewhat and strengthened since the photographs were taken, which are reproduced herewith. The elevator is driven by a 3-h. p. Fairbanks-Morse engine.[6] The concrete empties into a spout at the top and this is pivoted so that it can be moved around to cover the entire area, making pouring continuous. With this equipment and with 7 men on the job a house complete, except for the floor, which was previously made, and for the parapet above the roof, was poured in 3 hrs. The nature of the conveying apparatus serves as a continuation of the mixing process, so that when the concrete leaves the end of the conveyor it is in excellent condition and,



FIGS. 1 AND 2—A GENERAL VIEW AND DETAIL PART VIEW OF THE ELEVATING EQUIPMENT

so far as can be noted, without any separation of the fine from the coarse material. The resulting concrete surfaces are good and without pockets and almost free from pinholes.

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[1] From CONCRETE, Jan., 1916, p. 31

[2] Hydraulic Pressed Steel Co., Cleveland

[3] Elite Mfg. Co., Ashland, Ohio

[4] Nov., 1914, issue, p. 222

[5] Novo Engine Co., Lansing, Mich.

[6] Fairbanks, Morse & Co., Chicago

With the new system of forms it is possible in fairly good weather to remove the plates 24 hrs. after pouring. The ribs which hold the plates remain in place as long as may be necessary to support the walls. The forms can be stripped by eight men in one day and in that time given all the cleaning that is required. The surfaces are very smooth and with reasonable care the forms are expected to last a long time with but small depreciation.

In the construction of the cottages an unusually large amount of steel was required in order to conform to the building ordinance of Cleveland and for this job amounted to 5,032 lbs. at a cost of $105, cut to size. The floor slab has 5/8-in. and 3/8-in. round rods 12″ o. c., the walls 1/2-in. rods 15″ o. c., the roof 5/8-in. and 1/2-in. rods 12″ and 15″ o. c. Trussed rods were used over all wall openings, 5/8-in. rods in all pilasters and columns and 3/4-in. rods were placed in fan shape in the L of the porch. The earlier cottages built more than a year ago with far less steel have been entirely satisfactory.

Mr. Killaly felt that the building department of Cleveland was a little dubious as to the strength of the concrete owing to the method of mixing and depositing, so he took the concrete just as it came from the end of the conveyor and made three 6-in. cubes which showed an average strength at 28 das. of 1,779 lbs. per sq. in.

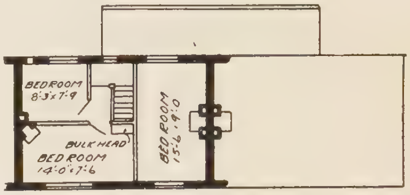
One of the cottages was given a crandalled finish. This work was done 7 wks. after the house was poured and one man's time was required for 5 das. to do it. Pilasters and corner columns and strips around windows and doors were left smooth for trim. One cottage had approximately 1,057 sq. ft. of surface to be finished and the total cost was $10.75, or approximately 1 ct. per sq. ft. This cost, Mr. Killaly says, can be greatly reduced by doing the finishing soon after forms are removed. Mr. Killaly says that a price of $6.00 should cover this work if it is done at the right time.

The present tendency to shorten the mixing time excessively is being considered with suspicion by many engineers; however efficient the machine, the time cannot be cut to extremes without sacrificing quality.

English Rural Two-Family Cottages of Concrete Block and Stucco[1]

The accompanying illustrations show concrete block two-family cottages built in Kent, England, for the Crayford Cottage Society, under the direction of the Rural Housing Organization, on an estate which is being laid out for nearly 500 cottages and for several public buildings.[2] The estate will also provide for recreation grounds, village green, bowling green and various other open spaces. The site adjoins the river Cray and is close to the village of Crayford. The construction work is being done by the Cottage Const. Co., London. So far cost comparison between brick work and concrete block work shows results greatly in favor of concrete block. While practically all of these houses are similar in plan, they are varied a great deal in the elevation to avoid monotony. Each dwelling has a frontage of 24′ 4½″ and a depth of 17′ for the main building, with a projection of 6′ for a total length of 12′ at the rear of the ground floor. The accommodation on the ground floor consists of a living room, 16′ 6″ x 11′, a parlor 12′ 4½″ x 9′, a scullery, bath and larder and fuel store space, and on the first floor there are three bed rooms, the largest being 15′ 6″ x 9′ and the smallest 8′ 3″ x 7′ 9″. Each floor has a height of 8′. The arrangement is shown in the accompanying plans. The contract price per cottage built with concrete block without any extras, is from £175 to £179, or from about $850 to $870, while the cost of brick cottages of the same plans was about $60 more than this per cottage. The extras, which are not included in this price, refer to gable and pitched roof changes, necessary to secure external variations.

In the construction of these houses concrete block made on a standard dry-tamp machine[3] were used. The block are 9″ x 9″ x 16″ and are made from a mixture of 1 part cement to 5 parts gravel, material all passing a 3/4-in. mesh. The block are allowed a curing period of 14 das. and so far extremely wet weather has made sprinkling unnecessary. The interior partitions are built with cinder concrete slabs 2¾″ thick made on the same machines as the concrete block . Chimney flues and stacks are also built of block, special block being molded for flues. Gables are finished at the top with block having a splay to fit to the roof. The second floor is of ordinary wood joist construction boarded on top and plastered below, while the ground floor of concrete is finished with boarding nailed to sleepers inserted in the surface concrete. The exterior surfaces are plastered with a mixture of cement, sand and waterproofing and finished with rough-cast. This surface stucco is depended upon to keep out moisture, as the block themselves are not made with the idea of resisting percolation, although they are plenty strong enough for the construction. All interior wall surfaces are plasterede except those in the scullery. These surfaces are covered with a water paint.



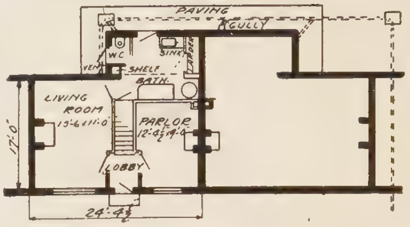


Fig. 2—Second Floor Plan, Crayford House

Fig. 3—First Floor Plan, Crayford House

It is a generally accepted fact that rich cement mortar will bond to a concrete surface provided the surface is cleaned and the aggregate exposed. When joining surfaces in compression the old surface should be cleaned, roughened and wetted. When joining surfaces in tension the wet and rough surface should be coated with rich mortar before new concrete is placed.

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[1] From Concrete, Jan., 1916, p. 29

[2] Data, courtesy *Concrete and Constructional Engineering*, London

[3] Winget, Ltd., London

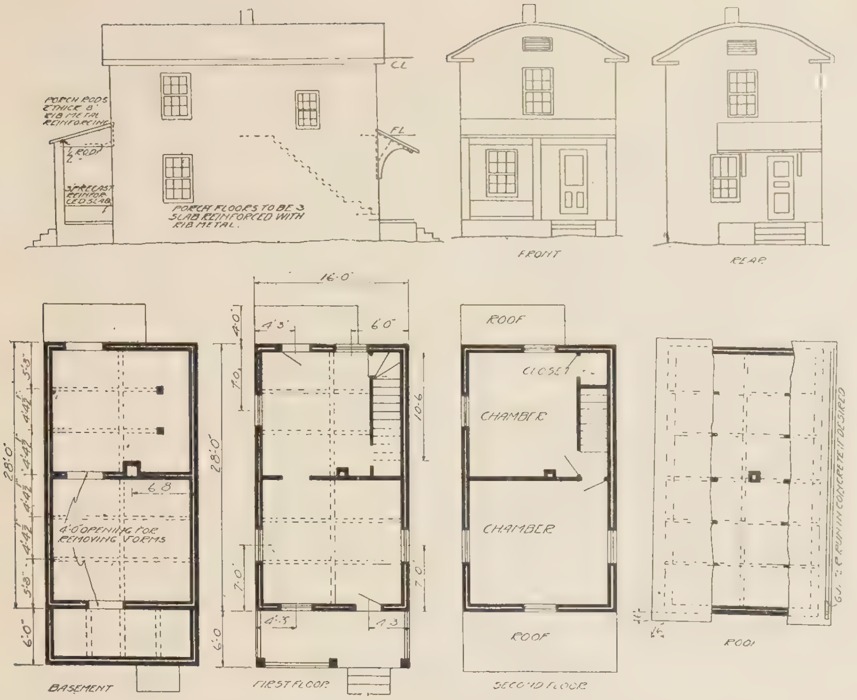

FIG. 1—PLANS AND ELEVATIONS OF LOW COST INDUSTRIAL HOUSE

Proposed Low Cost Houses for Industrial Operatives[1]

BY C. D. GILBERT[2]

The problem of housing employees at industrial operations remote from large towns where large numbers of foreign laborers are employed is one that has been given much attention during recent years.

The house here described was designed by the author for a large coal mining company; it was intended to build a group of these houses, provided that concrete could be used economically. Investigation proved that in this instance, owing to the great distance which concrete materials must be transported, the concrete house was uneconomical as compared with other types but where concrete materials are available at reasonable cost it is believed that unusually comfortable and low-cost buildings can be constructed along the lines indicated. It is obvious that the methods described could be adapted to other floor plans providing all the buildings are to be alike.

DESIGN

Inspection of the plans will show that the houses consist of four rooms, the living room, kitchen with stairway, and two bedrooms on the second floor. Provision is made for electric lights and water is to be brought into the house. Careful consideration has been given to having the buildings perfectly insulated and models of sanitation. The concrete construction and the almost entire absence of trim will enable them to withstand the abuse to which houses of this character are subjected. They can be flushed out with a hose and thoroughly cleaned when necessary, without damage to any part of the structure. Serious fire would be impossible.

An arched roof is used which provides ventilated air space over the bedrooms and makes them comfortable in all seasons. This type of roof presents a better appearance than the steep pitched roof generally used on wood houses of this character. It is very simple to construct and no upkeep should be necessary.

CONSTRUCTION

The house is designed to rest upon poured concrete footings or trench walls. The floors are to be of reinforced concrete beam and slab construction and an air space is provided under the lower floor. The walls of the building are double and designed to be constructed with a hollow wall machine[3] although where it seems desirable double block construction can be used. Floors are designed to be cast by means of a series of unit cells or forms in the shape of inverted boxes supported on planks which form the beam bottoms. This construction is clearly shown in Fig. 2. Two sets of forms should be provided, one for each floor. The roof form consists of five sets of rafter forms, two sets of end cornice forms and two sets of forms for the cornice at the sides of the building. These side forms are supported by the walls and by the staging as illustrated in Fig. 2. The projection of the side cornice forms gives a bearing for the end forms which can be bolted against the concrete wall. The rafter forms act as trusses and support light curved panels on which the roof slab is poured. Cornice, rafter and roof slab should be poured as a monolith. The porch walls can be of the same construction as the house walls, and the floor slabs reinforced or placed on fill. Unit forms would be made for constructing the porches. The porch railing could probably be best worked out as

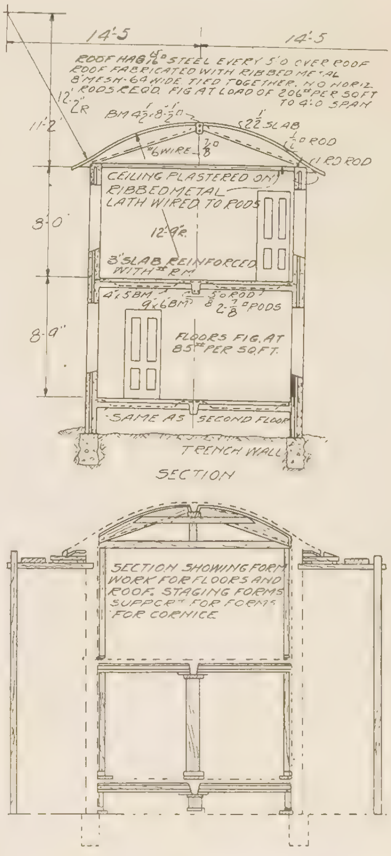
14'-5
14'-5
CEILING PLASTERED ON RIBBED METAL LATH WIRED TO RODS
8'-0"
8'-9"
FLOORS FIG. AT 85# PER SQ. FT.
SAME AS SECOND FLOOR
TRENCH WALL
SECTION
SECTION SHOWING FORM WORK FOR FLOORS AND ROOF. STAGING FORMS SUPPORT FORMS FOR CORNICE

FIG. 2—FORM AND REINFORCING DIAGRAM

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[1] From CONCRETE, June, 1916, p. 258

[2] Assoc. Editor of CONCRETE

[3] Van Guilder Hollow Wall Co., Rochester, N. Y.

a pre-cast slab. If a considerable number of houses are to be erected it would be desirable to construct two sets of floor and roof forms; this would enable these forms to be removed as fast as the concrete walls could be built with a machine. The surfaces left by the wall machines are rough and form a perfect key for plaster. No attempt would be made to have the structural walls waterproof but the walls would be given a heavy coat of stucco which would waterproof them for all practical purposes. The air space would provide exceptionally good insulation.

The interior walls would be finished one coat with a cement mortar continuously with the top surface of the floor. These walls could be given a coating of cement paint if desirable, but this has not been figured in the estimate.

ESTIMATE OF COST

EXCAVATION

Excavation (trench)	10	cu. yds.

FOUNDATION

9.77 cu. yds. concrete, 12-in. wall below grade	10	cu. yds.

ESTIMATED QUANTITIES OF CONCRETE

OUTER WALLS

1,716 sq. ft. 8-in. wall+55 sq. ft. for gables	44	cu. yds.

PARTITIONS

Cross wall 14′ x 3.5′	33 cu. ft.	
Partition 14′ x 17′	79 cu. ft.	
	112 cu. ft.	
2 piers in cellar	7 cu. ft.	
Stair partitions 13′ x 17′	68 cu. ft.	
Total	187 cu. ft.	
	or	7.0 cu. yds.

FLOORS

2 floors	7.5 cu. yds.
Beams	1.5 cu. yds.

ROOF

Slab 20.5′ x 30′=615 sq. ft.	8.0 cu. yds.

PORCHES, ETC.

Front porch foundation	4.0	cu. yds.
Porch floor	1.0	“
Steps	1.0	“
Column and beams, porch columns, beams and roof	2.0	“
Balusters	.5	“
Stairs	1.0	“
Rear porch, ⅔ of front	6.0	“
Chimney	1.0	“
Total yardage	94.5	cu. yds.

Concrete, rough, 100 yds. @ $2.40	$240.00
Inside plaster (one coat), 312 yds. @ 20 cts.	62.40
Outside plaster	40.00
Reinforcing, as per plan[4]	60.00
Labor and mixer	166.00
Window and door frames and sash	40.00
Outside doors	8.00
Inside doors	15.00
Flue lining	4.00
Wiring	12.00
Stairs	20.00
Painting	10.00
Total cost of house	$677.40

DETAILED LABOR ESTIMATES FOR TWO HOUSES

14 das. operator @ $4.00	$ 56.00
14 das. 4 laborers @ $8.00	112.00
Labor for setting forms for floors and setting floors	150.00
14 das. for mixer @ $1.00	14.00
	$332.00
Labor cost per house	$166.00

MEMO

No allowance for staging lumber.
No allowance for floor and roof forms (which will cost about $150 to $200), to be divided among the houses built.
No allowance for investment in the Hollow Wall Machine.
No charge for superintendence.
Walls are figured solid, estimated on the basis of 100 yds., 4 yds. in excess of actual figures, nothing deducted for openings.

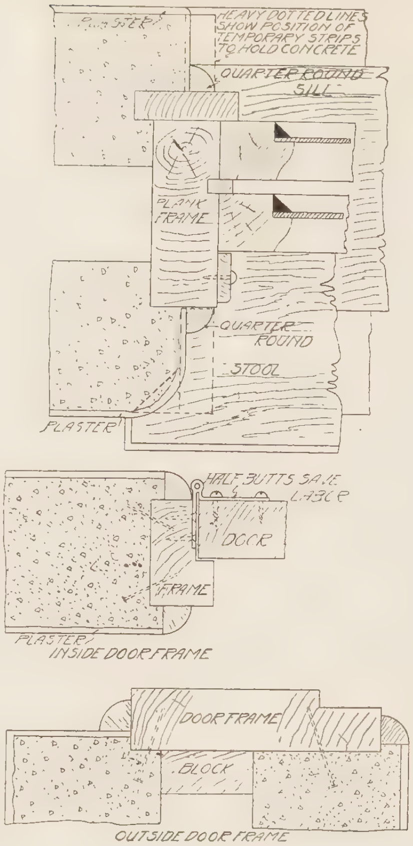

FIG. 3—DETAILS OF TRIM

INTERIOR TRIM

Inspection of the details will show that woodwork has been reduced to a minimum. Partitions could be of frame construction but preferably of concrete poured in unit forms or laid up of special block. The wood trim would consist merely of a quarter-round attached to the wood frame or even better, a quarter-round metal trim,[5] which is now obtainable.

Window frames are equally simple and no balances are provided for. If found desirable it would probably be more satisfactory and economical to use a spring balance than weights.

Reinforcing for the floors and roof is well shown in Fig. 3. The walls would be reinforced with ½-in. rods in the wall below and above window openings, these rods being carried entirely around the wall. No vertical reinforcing would be required. One-inch round rods are provided to take the thrust at each pair of rafters. These rods are tied to the center of the roof to prevent sagging and to them some type of ribbed expanded metal is wired and plastered, forming a suspended ceiling.

COST

Estimates were based on wholesale buying and labor at rural prices. They do not include lumber for staging or cost of floor and roof forms or the wall equipment. The set of forms for floors and roof could probably be built for about $200. This and the cost of the wall machines would be divided among the number of houses to be built. It is assumed that a small mixer would be available and not purchased for this special work. A charge of $1.00 per da. is made for the mixer. Superintendence and overhead are not included. In figuring concrete quantities no allowance is made for openings which should make good waste and shortage.

Stucco on Concrete

The great fault of stucco as now used is that it is not what it proclaims itself to be. It is an imitation, a makeshift. The designs of the vast majority of stucco houses express the feeling of masonry or more properly monolithic construction. Undoubtedly this apparent massiveness and appearance of permanence accounts in a large degree for the enthusiastic reception of this material by the public, which realizes the flimsiness of the frame buildings which constitute our national fire peril.

Stucco is not a structural material, it is only a finish—the skin which clothes the structural body. The application of a skin purporting to be concrete to a frame of wood is illogical and, as experience often shows, disastrous. Stucco applied to clay tile and to brick is more true and logical, but in practice the fact that Portland cement and clay products have very different coefficients of expansion with changing condition of moisture and temperature has made this combination less desirable than it otherwise would be.

The logical application of stucco then is to the structural material it purports to be—concrete. For convenience the concrete base may consist of units such as block or tile or it may be applied to monolithic walls with entire success.

Concrete which is to receive stucco should not be too dense, at least at the surface. It should have a mechanically rough face and the quality of absorbing a certain amount of water which assists in curing the stucco as well as giving proper bond. The stucco skin itself will resist the action of the weather while dryness and even temperature are secured by proper air-spacing within the structural wall and by intelligent ventilation.

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[4] This figure based on normal steel prices

Concrete material costs, based on sand and gravel per cu. yd	$1.00
Cement per bbl	1.40
	$2.40

[5] Carter Sheet Metal Co., Omaha, Neb.

[6] Elgin New-Way Metal Trim Co., Kansas City, Mo.

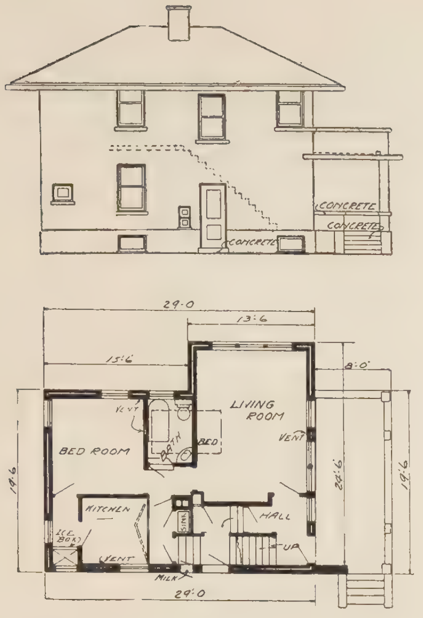

Fig. 1—Plan and Side of Band-box Apartment

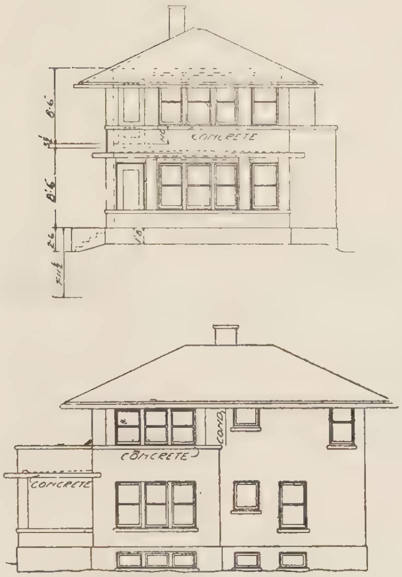

Fig. 2—Front and Side Elevations

A "Band Box," Two Family Apartment, to Be Built of Concrete[1]

By Glen M. Rees[2]

Designed to meet the demands of economy in space and expenditure, the construction and arrangement of this unique low-cast apartment holds place in the hot pace set by concrete designers and students of hygiene and modern living. The building is extremely economical as to maintenance, being constructed with concrete walls, floors and roof and metal window sash and frames.

While a number of construction methods are available for working out these plans in concrete that selected is the so-called thermos bottle construction erected by means of a hollow wall machine.[3] This construction is, in reality, one house within another, with an air space of 2½″ between the walls, each wall being 4″ thick. This construction makes a dead air space except for vents, and has proved its value in reducing the winter coal bill, as compared with wood frame.

DESIGN AND CONSTRUCTION

The arrangement is very compact, being laid out on the lines of a city apartment, but is more desirable on account of the great amount of light possible. Three rooms and a bath are provided; a good sized living room with bay window, a kitchenette with small cooking closet combined with dish cupboards, ice box, range, etc. The kitchenette is separated from the stairs by a folding screen on rubber rollers so that the whole space can be opened up for a dining room in the event of the adjoining rear room being used as a bed room, which is not necessary when there are but two in the family, as it is arranged to have a sanitary and ventilated bed slide under the raised floor of the bath room.

The end of the iron bed which projects in the living room is finished as a couch or other piece of furniture to suit requirements. The bed, when rolled in, has a galvanized iron case, making it dust proof and air tight from the room. The case is connected at the bottom with a fresh air stack and at the top with a vent stack, which provides a free and positive circulation of fresh air over the bed at all times. Each room has a vent stack in the hollow concrete wall, which discharges under the cornice; vents of baths and of kitchens are at ceiling and those of living room and of bed room at floor.

The apartments are heated by separate furnaces. Furnace heat is especially advantageous, as fresh air must be brought in through the fresh air ducts.

FLOORS AND ROOF

The floors are designed to carry a live load of 50 lbs. per sq. ft. and are 5½″ thick in large rooms. The small rooms do not require this thickness but are left the same in order to facilitate the form work and construction. The reinforcing in floors is to be expanded metal of about 2½-in. mesh and 3/32″ running in direction indicated. The concrete floor slabs are covered with ⅞-in. oak flooring on 2-in. x 2-in. wood sleepers. The roof is a 4-in. slab reinforced with rods and overlaid with expanded metal the same as floors. Over the slab is spread ordinary wire chicken netting, to be covered with ¾″ of very rich cement mortar, which is to be cut through with a marking tool to the netting in squares 2′ x 2′ or less, the joints to be filled with asphaltum or other elastic waterproof pitch. The roof surface will be troweled smooth and waterproofed with R. I. W.[4] The outside of building will be stuccoed and painted with two coats of waterproof cement paint.

COST

Contract prices received by the builder, H. E. Kondolf, are given in itemized form and indicate a cost of $5.50 per sq. ft. of area on the ground. It will be noted that few flats constructed with one family above the other can be built entirely of wood for this price.

Estimated Cost of Band-box Apartment

112 yds. sand and gravel @ $1.25...	$ 150.00
182 bbls. cement @ $2.00, less $54 for sacks	310.00
5 tons of plaster @ $7.50 per ton...	37.50
Wire mesh and reinforcing steel....	103.03
1,000 brick	20.00
Mason labor	312.00
Flashing and tin work	15.00
Floors and sleepers	110.00
Heating system—two furnaces	190.00
Plumbing complete	365.00
Electric wiring	125.00
Painting and finishing	140.00
Interior trim and mill work	447.00
Carpenter work	186.00
Metal frames, sash and glass	763.00
The substitution of wood frames, doors and sash would save $400 on this item	
Light fixtures	60.00
Hardware	40.00
And adding for incidentals	100.00
	$3,473.53

It is far too common practice to leave mixers and other mechanical equipment exposed to the weather when idle. A good tarpaulin cover costs less than 1% of the cost of a new piece of equipment and is low insurance.

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[1] From Concrete, Feb., 1916, p. 61

[2] Archt. and Engr., Rochester, N. Y.

[3] Van Guilder Hollow Wall Co., Rochester, N. Y.

[4] Toch Bros., N. Y. C.

A Double Wall Concrete House Economically Built in Cold Weather[1]

By Carl W. Baumgardner[2]

Circumstances prevented work being started on the house which forms the subject of this article, until about the middle of Nov., 1914. Fair weather was experienced until Thanksgiving Day, when it grew colder and began to freeze. As the weather became colder we were forced to heat materials. By securing from a local junk shop a discarded tank, we made a very satisfactory heater, shown in Fig. 2, and, by using several coils of pipe, connected to the water supply inside the heater, had plenty of hot water.

Walls and partitions of the house are constructed with a hollow wall machine,[3] doing away with wall forms.

The floors are carried on 5-in. boiler tubes, over which was laid electric welded galvanized wire fencing and upon this was poured a 6-in. 1:2:4 cinder concrete rough floor. This floor was left in the rough until after the house was white-coated, when a terrazzo marble mosaic floor was laid·

After the cinder concrete was hard enough to work upon, we built up the main walls of the house.

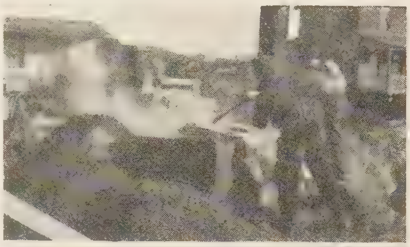

Fig. 2—Improvised Heater for Aggregates

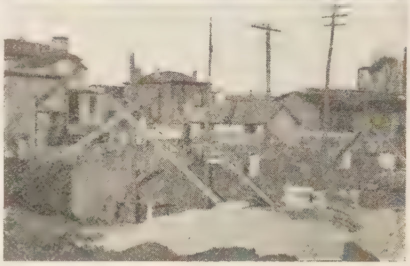

Fig. 3—Starting Construction Work

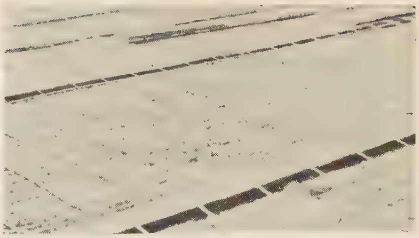

Fig. 4—Wire Mesh Ready for Concrete

From the plans it will be seen that the arrangement of the rooms wastes little space. The rear porch is enclosed with doors, sash glazed, and gives protection from heat and cold. Underneath the rear porch, the floor of which is a concrete slab with a manhole, is a 100-bbl. cistern. The arrangement of the cellar is very convenient. It is equipped with full set of plumbing, including hot and cold soft and city water at laundry tubs, electric connection for washing machine and drying room for clothes.

Before applying plaster to the inside of the cistern the walls and floor were given two coats of Toco bond.[4] No dampness or seepage has appeared inside the cellar from the cistern.

The plaster is applied directly to

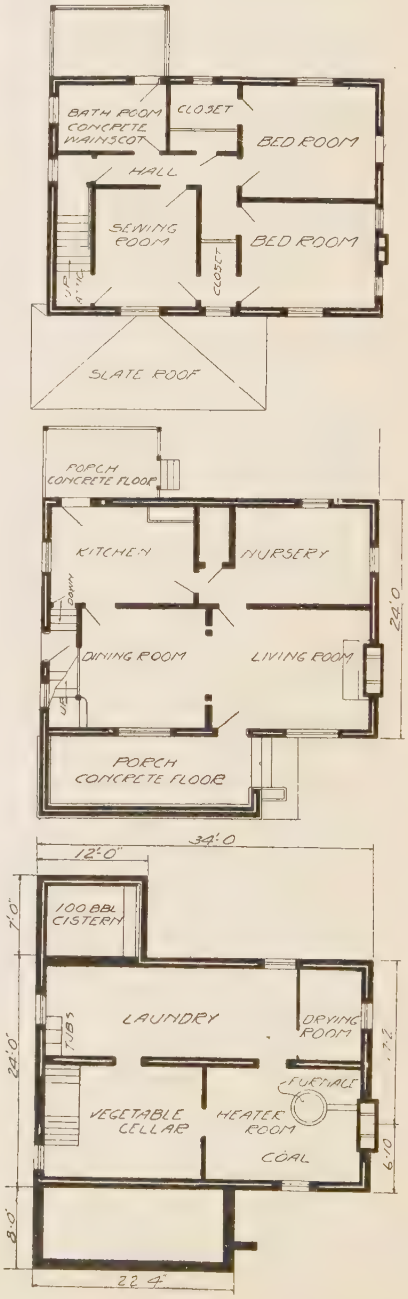

Fig. 5—Floor Plans, Baumgardner House

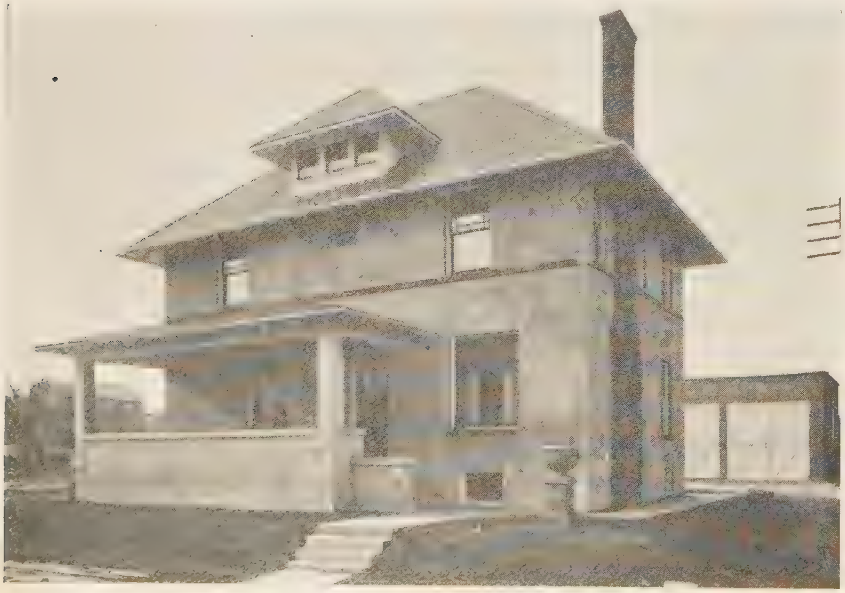

Fig. 1- Fireproof Residence, Tiffin, Ohio

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[1] From Concrete, Mar., 1916, p. 111

[2] Baumgardner Concrete Products Co., Tiffin, Ohio

[3] Van Guilder Hollow Wall Co., Rochester, N. Y.

[4] Tropical Paint & Oil Co., Cleveland

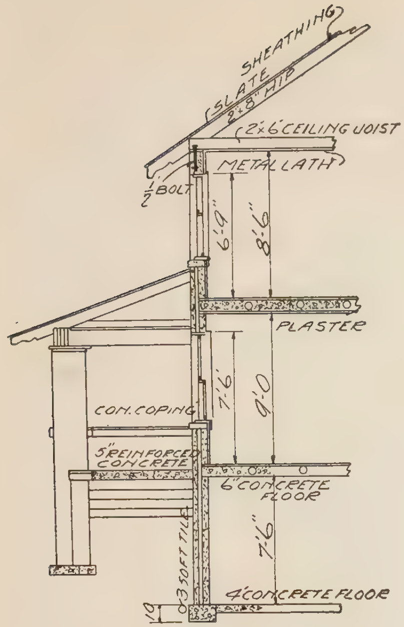

Fig. 6—Section Double Wall House

the inside walls, the insulation provided by the 2-in. air space around the entire building making furring and lathing unnecessary. No dampness has penetrated to the inside walls. The amount of plaster used was about ¼ less than when placed on lath.

The stucco finish was applied directly to the outside walls, the machine leaving a surface sufficiently rough to secure a good bond. The stucco consists of one smoothing coat of cement and lime mortar, over which was placed the finish coat of Medusa White[5] cement and marble dust,[6] applied with an automatic stucco machine.[7]

The partitions thorughout are of reinforced concrete and the only things combustible about the house are the interior finish and the framing which carries the slate roof. There is a tapestry brick fireplace with ½-in. raked joints in the living room. Marble squares set at the time of laying the mosaic floors form the hearth. The house is heated by a 20th Cenutry 24-in. grate hot air furnace[8] and has wall registers in every room.

The complete cost of the house is about $3,000, itemized as follows:

Cost Data

Labor:		
Digging cellar	$ 25.75	
Masonry and concrete (day work)	470.44	
Carpenter labor	501.18	
Plastering and lathing	90.60	$1,087.97
Materials:		
Reinforcing	$ 37.00	
Cement, 150 lbs. @ $1.28 net	192.00	
135 tons No. 7 stone sand @ $1.10	148.50	
2,000 tapestry brick @ $20	40.00	
Sewer pipe	9.78	
Lumber and mill work	544.88	
Plumbing and fixtures	225.83	
Lath	38.50	
Plaster	19.60	
Slate roof (contract)	157.15	
Electric wiring and fixtures	90.00	
Hardware	38.54	
Nails	8.39	
Painting (contract)	85.00	
Marble mosaic floors	130.26	
20th Century furnace, installed	125.00	
Mantel, gas logs and andirons	29.00	1,919.43
		$3,007.40

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[5] Sandusky Portland Cement Co., Cleveland

[6] Conlin & Co., Tuckahoe, N. Y.

[7] Automatic Stucco Mach. Co., N. Y. C.

[8] 20th Century Heat. & Vent. Co., Akron, Ohio

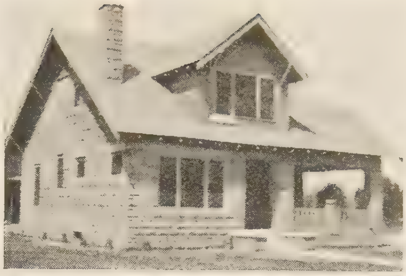

Fig. 2—A View of Cottage Soon After Construction

An Engineer's Concrete Block Cottage—Built in Riverside, Cal., for $3,000[1]

By Rolf R. Newman[2]

Why should an engineer build a concrete cottage—particularly a concrete block cottage? Answer: (1) The block feature, including the alternation of wide and narrow courses, was especially desired by the friend for whom the house was constructed. (2) It was believed (and proved true) that a house of this "story-and-a-half" type, either in concrete or in concrete block, would involve interesting "how-to-do-it" features worthy of working out. (3) I believe, with Benjamin A. Howes, that "building contractors on the professional plane" can be of assistance in any and all parts of the building world of today.

The effort was made to see what could be done in an isolated house of this type for about $2,500, but on account of the later addition of a Solar heater and certain other betterments, the actual cost was slightly over $3,000—an exact segregation of the principal items being as follows:

Carpenter work—labor and material for rough and finish	$1,354
Concrete work—block, lintels, porch floors, steps, etc.	908
Plumbing	325
Plastering—inside, two coats direct on block	200
Painting	97
Electric work—wiring, fixtures and gas in kitchen	70
Hardware—rough and finish	60
Total	$3.014

The distribution of cost to the owner on a five-payment basis was worked out as follows: (1) 1-5 when block walls are finished to height of second story. (2) ⅕ when roof is on. (3) ⅕ when plastering is completed. (4) ⅕ when house is entirely completed. (5) ⅕ legal period to free all aliens in California, 31 das.)

The house was built for R. J. Nel-

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[1] From Concrete, Jan., 1915, p. 20

[2] Civ. Engr., Riverside, Cal.

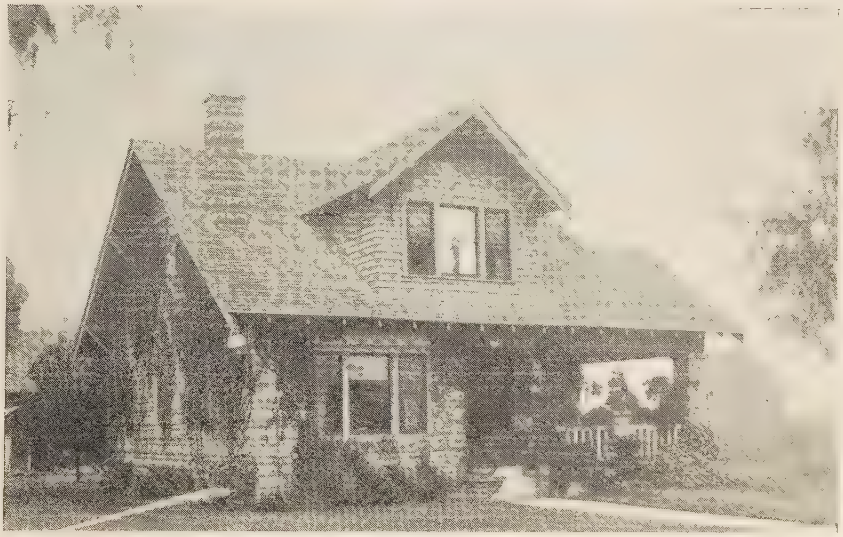

Fig. 1—Concrete Block Cottage, Riverside, Cal., After Two Yrs. in Which to Grow Into the Landscape

son, Riverside, Cal., but before completion he sold it to A. H. White, the present owner and occupant. Mr. White is an experienced California orchardist and has himself planted and tended the vines and plants that have so completely covered the cottage in two years' time. Four mos. was the time required to build the house and it was finished in the summer of 1912.

The first step was the manufacture of the block at the site of the house on a standard 8-in. x 8-in. x 16-in. Ideal[3] block machine. While the block were being made the excavation for cellar was made and solid concrete cellar walls, foundation walls and fireplace foundation were placed. The cellar hatchway and steps are also of solid concrete. The earth excavation for cellar and hatchway was trimmed vertically to a sufficiently true line to use it for the rear form, a wooden panel being used as the inside form and concrete being poured between the wooden form and the earth wall at the rear. This is a saving in form work which it is always good to try for if the ground in which work is being done will stand up.

All the sills and lintels were cast at the site. The lintels were cast separately in the same form, which consisted of a bottom and two side pieces of surfaced 2-in. plank long enough to cast the longest lintel (9′ 8″) with movable wooden end gates which were set in the form at any distance apart required to cast a lintel of a certain length. The face of the lintel to be exposed was cast down against the bottom of the form and all were reinforced. Not one was broken in raising them into place by hand power, but to avoid unnecessary handling of the longest one, which weighed approximately 800 lbs., it was cast on a platform on a level with and just opposite its location in the wall and when hardened it was rolled over into place. The lnitels, as well as the block, were given a $\frac{1}{2}$-in. facing of 1 part cement to $2\frac{1}{2}$ parts of sand, the backing being a regular $1:2\frac{1}{2}:4\frac{1}{2}$ concrete—the coarsest particles of rock being not over $\frac{3}{4}''$ in diam.

These, as compared with Fig. 1, show the value of vines and plants in architecture

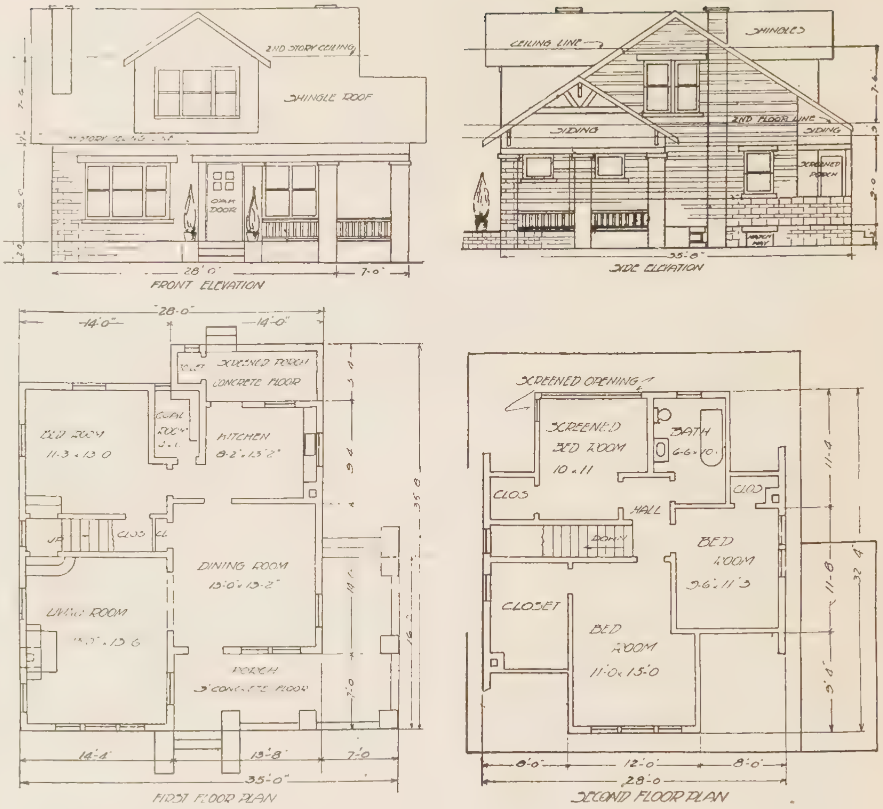

Fig. 3—Floor Plans and Elevations, Concrete Block Cottage

The concrete block in the gable ends were carried up only to the top of the second story windows—the peak of the gable being finished in wood in connection with the wooden roof. Rafter plates of 2-in. x 6-in. rough pine were bolted to the tops of the front and the rear walls; to these the wooden rafters were nailed. The first and the second story floor joists fitted into notches in the block of the exterior walls and had a 4-in. bearing surface on these walls so that in every way the concrete and the wooden portions of the building were tied together as firmly as possible. The only interior walls of concrete block are those of the cool room, which insulate this room from the kitchen and other portions of the house. The re-entrant feature at the center of the rear wall, together with the buttress effect of a chimney built into either side wall, and the column and wall arrangement at the front gives the house wonderful stability and compactness. When it is considered that the net ground area covered is 28′ x 36′ or approximately 1,000 sq. ft., it will be recognized as quite worth while that so substantial and approximately "fire-safe" a house can be built for as low as $3.00 per sq. ft. of ground area.

It must be further recognized that the "story-and-a-half" type of house embodies many advantageous features of appearance and of economy for the following reasons: (1) The relation of wall area to roof area is such that good proportions are easily maintained, even by those not greatly versed in architecture. (2) The amount and location of the concrete in the exterior walls of this type of house are such as to derive a maximum benefit without incurring the undue expense of raising it as high as even a full two-story house would require. (3) The arrangement of rooms with some below and some above has a recognized economy over any arrangement of the same number and size of rooms, all on one floor.

As to the contractor's plant (aside from the carpenter's tools furnished by my foreman and men working under him) necessary to build this house, $200 would cover it, including block machine, wheelbarrows, shovels, rope, etc. To build the same house all in reinforced concrete, using wooden forms, would require an investment in "plant" of at least $400; and the best figures I have on steel forms would indicate a minimum investment in "plant" using steel forms of $1,000. The "plant," to be sure, is in all cases available for the next job, but we see in these figures a reason why, in the absence of a greater public demand for reinforced concrete, block have remained a "standby" of the small builder.

My complete "crew" on this job consisted of a foreman, familiar with both carpentry and concrete work, and five men (including two who were employed in making the block). The foremen received $3.75 per da. of eight hrs. A regular carpenter with him received $3.50. Two carpenter helpers received $2.50 each. The man at the block machine (who also later laid the block) received $3.00 per da. and his helper received $2.00 per da.

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[3] Ideal Concrete Machy. Co., Cincinnati, Ohio

Hollow Wall Bungalow Built With Home Made Machine[1]

By Henry L. Wilson[2]

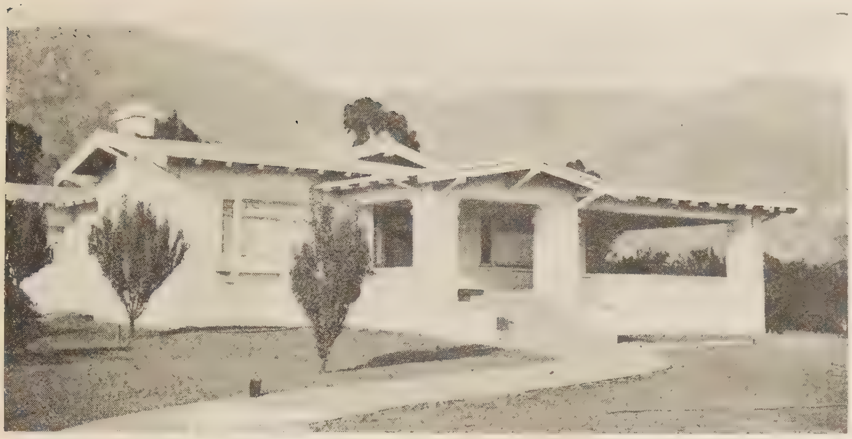

Fig. 1—A Concrete Bungalow in the California Mountains

The accompanying illustration shows a nine-room bungalow recently designed and built by the writer for Rev. Seth O. Rees in Pasadena, Cal.

The bungalow is constructed with hollow concrete walls. The forms are my own idea and have proved a sucess both in durability and low cost. Two 3-in. concrete walls with a 2-in. air space between form the wall section. The walls are bonded by metal studs made from 24-ga. galvanized sheet metal cut in strips 6″ wide x 9′ long. Both edges of the studs were turned back with a ½-in. circle which stiffens the studs and forms a clinch in the concrete walls. The foundation walls were put in in the usual way, a solid 10-in. wall to floor joists; the metal studs were then set up edgeways across the wall on 18-in. centers and were held in line by a temporary plate at the top. The hollow walls were then started on the foundation.

FORMS

The forms used consisted of two pieces of ordinary 2 x 10 lumber 6′ long, two iron clamps made of 1 ¾-in. channel iron bent U-shaped to fit over the outside of the form boards and to hold them in place while the concrete was being put in. Near each end of the boards a small steel pin was driven through near the bottom edge projecting about 2″ to catch on top of the wall and to hold the forms up in place. The cores were made of wood 2″ thick, 10″ deep and 18″ long, with two large screw-eyes in the top by which to pull them out. There cores were placed between the metal studs; the 2 x 10's were placed at each side, the clamps placed over them; they were then filled with semi-wet concrete, well tamped, when the cores were pulled, the clamps removed and the boards moved forward their length, set up and refilled, and so on around the house to the starting point. By that time the concrete had set sufficiently to permit another course to be placed and so on until the walls were finished. A set of these forms cost less than $5.00.

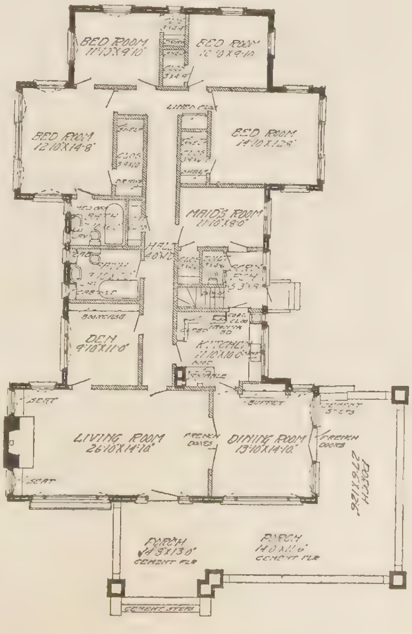

Fig. 2—Floor Plan of Bungalow

GENERAL FEATURES

After the rough concrete walls were up they were finished with Atlas white cement[3] and silica sand; the insides of the walls are plastered directly on the concrete. Inside partitions may be built in the same manner, but in this bungalow 2 x 4 studs were used, lathed and plastered in the usual way.

The bungalow contains nine rooms and basement; living room, dining room and den; it has panel wainscoting and beamed ceilings, oak trim and oak floors. Living room has a tile mantel with book cases on either side. There is a large buffet in the dining room; the kitchen is fully equipped with all modern conveniences. A concrete garage large enough to acommodate two cars was also built, and the house and garage were constructed for about $5,000.

Soap-and-Alum Waterproofing

The soap-and-alum process in waterproofing has been used frequently by engineers of the War Department. It is described in the 1901 report of the Chief of Engrs., U. S. Army, as follows:

The soap-and-alum (Sylvester) process was used in "Waterproof mortar" and applied to both horizontal and exposed vertical surfaces. This mortar was made by taking 1 part cement and 2½ parts sand and adding thereto ¾ lb. of pulverized alum (dry) to each cu. ft. of sand, all of which was first mixed dry, then the proper amount of water—in which had been dissolved about ¾ lb. of soft soap to the gal. of water—was added and the mixing thoroughly completed.

The mixture is a little inferior in strength to ordinary mortar of the same proportions and is impervious to water, and is also useful in preventing efflorescence. The alum is in excess for the reason that it coagulates other things than soap that may come to it.

The process was applied in connection with concrete construction in fortifications at New York Harbor. Similar treatment is known to have been used somewhat extensively elsewhere in work of like character.

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[1] From Concrete, Jan., 1916, p. 30

[2] Archt., Los Angeles, Cal.

[3] Atlas Portland Cement Co., N. Y. C.

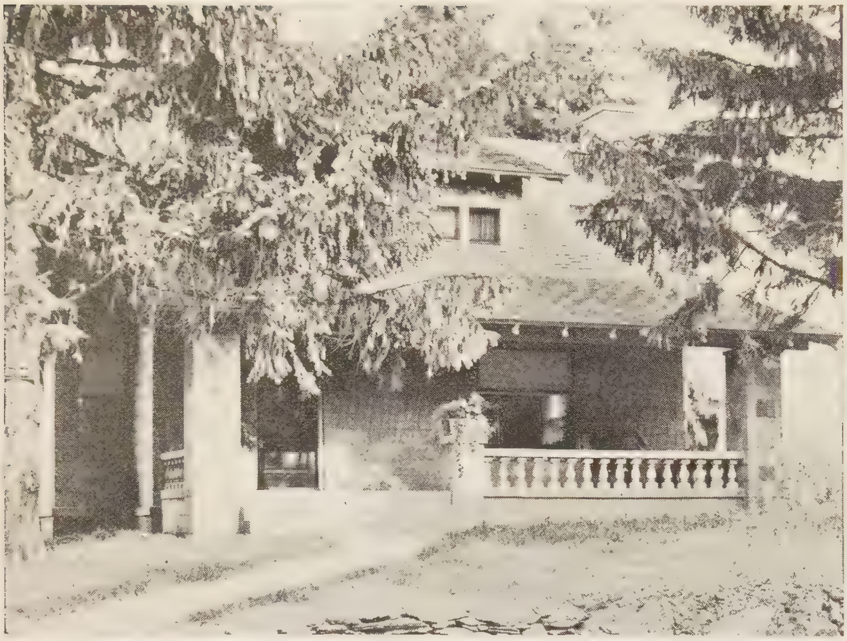


Fig. 1—Cottage Built by R. H. Bushnell, Poughkeepsie, N. Y., at a Cost for Concrete Work in Basement, Upper Walls and Porch, of $1,200

Attractive Concrete Block are Used in Poughkeepsie House[1]

The concrete cottage "Grey Nook," illustrated, is in Poughkeepsie, N. Y. The concrete work erected cost $1,200. The block used are of the two-lug type, like those used in the house at Mooseheart, Ill., but these were made in home-made wood molds. They are 3″ thick on the face with 5-in. lugs. The house was built under the direction of R. H. Bushnell for his own ocupancy, but was later sold.

An interior view of the wall under construction is shown in Fig. 3. This view shows the plugs to which furring strips were attached.

The basement walls are 13″ thick, of two-piece block; basement partitions are 6″ thick.

Figs. 4 and 5 show wall surface detail. Block have a scrubbed surface, exposing aggregates. A variety in the aggregates seems in excellent taste. Note the coarse texture of the basement wall in the lower part of Fig. 5 and the finer texture above and in the corner column of the porch note the contrasting tones of two different block faces and the system of laying.

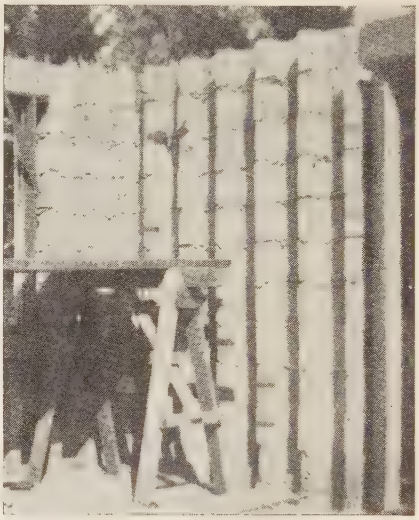


Fig. 3—Interior View of Block Wall Under Construction

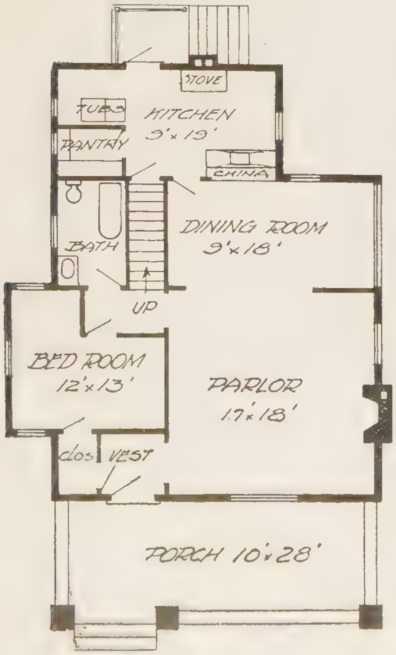
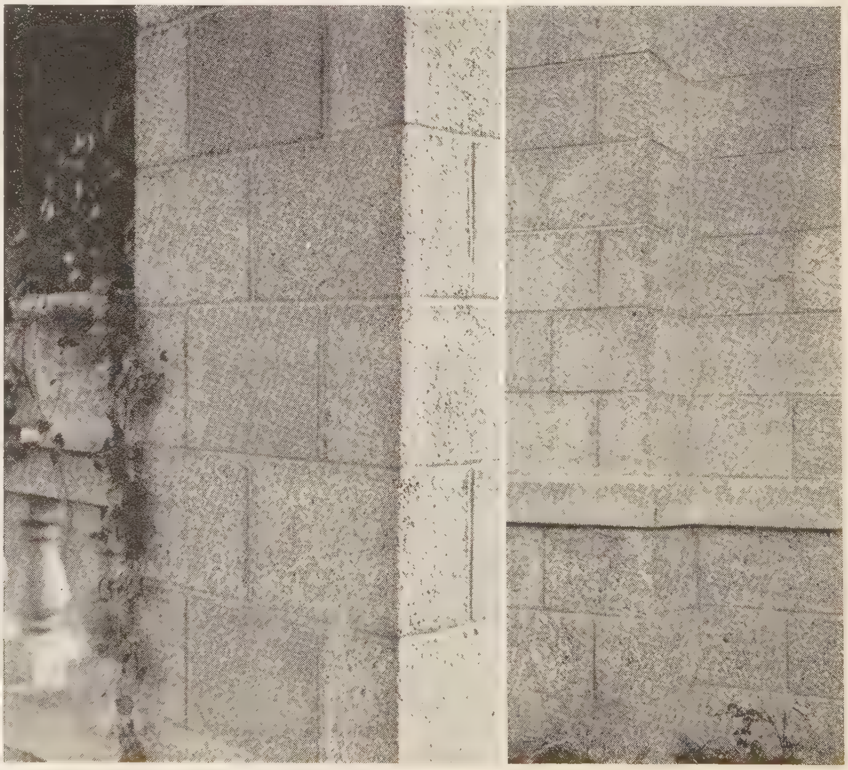


Fig. 2—First Floor Plan of Poughkeepsie House



Figs. 4 and 5—Detail of Porch Column with a Glimpse of Concrete Porch Balusters and a Detail of Wall at Chimney, Showing Contrasting Surface Finishes

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[1] From Concrete, Feb., 1915, p. 98

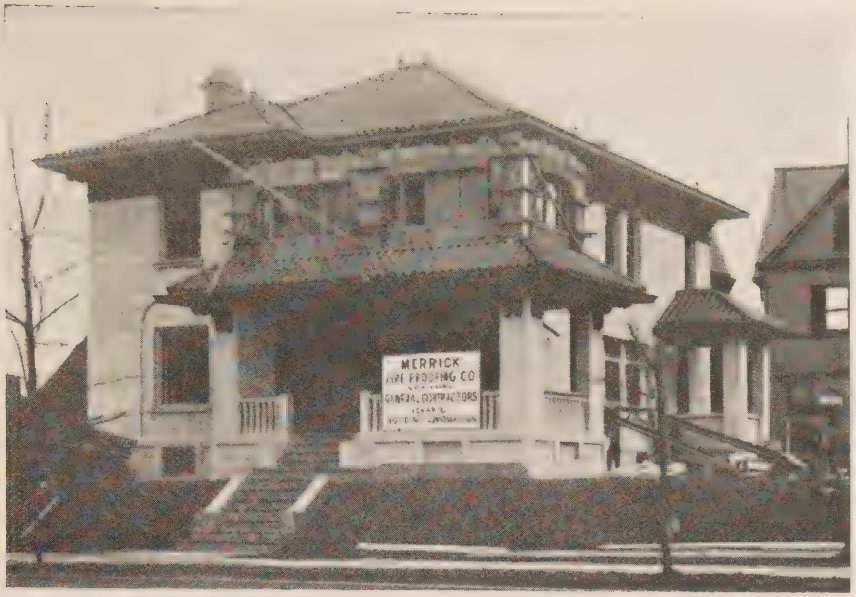

Fig. 1—Residence of Mrs. O. J. Stewart

A Concrete House With Tile-Lined Walls at Jersey City, N. J.[1]

By Charles F. Dingman[2]

The concrete residence described differs from many houses, in that low cost was neither the first consideration nor the determining factor in the choice of a building material.

The owner demanded a residence which, for its size, should be strictly first-class and which should be fireproof, comfortable, permanent and gain its attractive appearance from harmonious proportions rather than from architectural embellishment. Concrete was pre-eminently the material indicated by these requirements.

The architect, George W. Von Arx,[3] has succeeded in producing a well proportioned, comfortable looking house without excessive adornment.

No attempt will be made to describe the interior finish beyond saying that everything is of a grade to correspond with the exterior.

The wall section shows the care taken to get a wall that should be damp-proof as well as a heat insulator. While this type of construction may seem excessively costly, it has been justified by the fact that in some places expensive paneled wood wainscot is placed against the wall and that the wall has proven an excellent heat and moisture insulator. The rods shown in the drawing were placed as an insurance against contraction cracks rather than to add strength.

The floor construction is of the Kahn hollow tile and concrete type.[4]

Cornices are of copper, to give a contrasting color, and the roofs are of red Spanish tile. The sleeping porch, shown unfinished in the illustration, has a glass roof set in puttyless sash, while the sides are made up of metal casements.

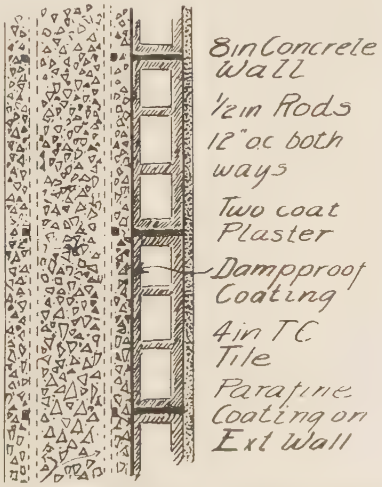

Fig. 2—Wall Section, Stewart House

Practically all of the concrete work was cast in place except the porch balusters, which were cast on the ground and set in place, after which the coping rail was cast on top. The walls were poured in wood forms and are lined with hollow clay tile. All walls, after removing the forms, were ground to a surface as smooth as possible by the use of carborundum brick.[5] Forms were left on until the concrete was comparatively hard, which made the cost of surfacing reach the rather high price of 8 cts. per ft. However, it is believed that this cost was justified by the fine appearance of the surface obtained.

The total cost of the house, excluding plumbing, heating, vacuum cleaner, electrical work and finished painting, was approximately 32 cts. per cu. ft., which is greater than the cost of a similar brick house, but considerably cheaper than a stone veneered house of the same style.

The house was erected for Mrs. O. J. Stewart by the Merrick Fireproofing Co.[6] Julius Bally was Supt. of Const. and the writer at that time was Secy. of the contracting company.

Beauty and Utility

Another thought as to the close allegiance of beauty and utility is gleaned from *Knickerbocker Komments:*

> One reason why there are so many unsightly houses built by carpenters is the misconception on the part of the public that the mission of the architect is principally to add "embellishments" to a building—with a commensurate addition to the cost.
>
> The public thinks that art, which is simply another name for beauty, is something apart from everyday life.
>
> Even a genius like Goethe wrote that the beautiful cannot be made to serve any practical purpose without injury to the artistic effect.
>
> This seems still to be the prevailing popular idea, despite the thundering of Ruskin, Morris and other aesthetic leaders, who preached that in art "form follows function."
>
> For example, no chair can be artistic unless it is useful as a seat. This statement is not so superfluous as it might appear at first glance. Some chairs are really not furniture—they are bric-a-brac. If you doubt it, look around in private parlors or in the "ladies' parlor" of fashionable hotels.
>
> If an art museum, instead of being called by that name, were featured as an "Exposition of the Beautiful"—in paintings, tapestry, china, furniture, etc.—it would be a much more popular institution.

---

[1] From Concrete, Mar., 1916, p. 110

[2] Engr., Flynt Const. Co., Palmer, Mass.

[3] Jersey City, N. J.

[4] Trussed Concrete Steel Co., Youngstown, Ohio

[5] The Carborundum Co., Niagara Falls, N. Y.

[6] N. Y. C.

Suggestions for Building Private Garages of Concrete[1]

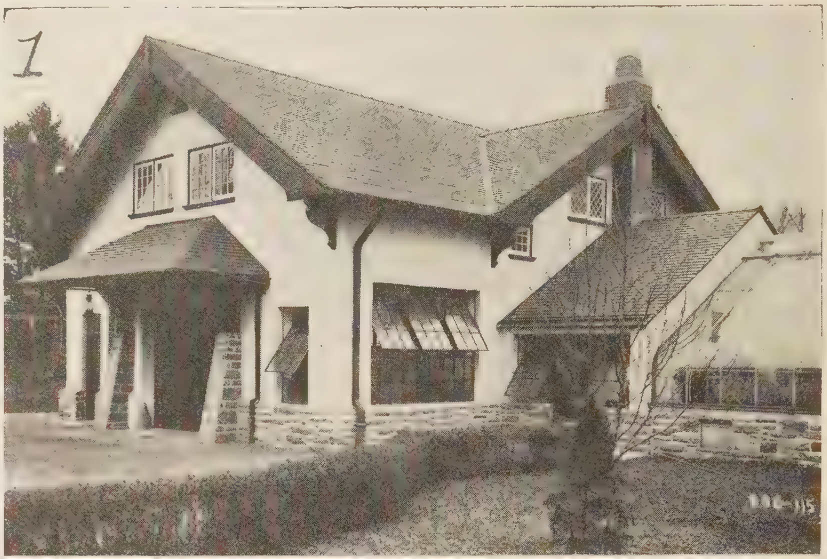

Fig. 1—Hollow Tile and Stucco, Concrete Floors

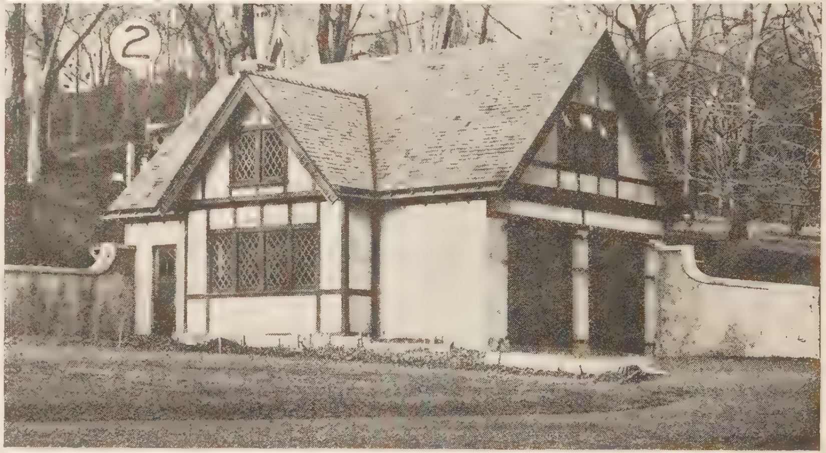

Fig. 2—Double Concrete Walls, Concrete Floors and Stucco

The construction of the private garage is one of the everyday problems of both the architect and the builder. It presents an opportunity offered by a few small structures to display resource in providing a fireproof building at moderate cost, a building that will have an individuality suited to its surroundings. There is endless opportunity to add refinement of detail. A suggestion that will sometimes add to the value of the proposed job for both owner and builder is its combination with some other building needed by the owner, a billiard room, studio, shop or den.

Salesmanship plays a large part in profitable fireproof garage construction; small garages can often be made profitable, but specialization is desirable as the contractor who builds 20 garages in a season can give better service and make a better profit than he who builds but one or two.

Prospects can be secured by working with local automobile dealers who generally know of contemplated buildings. Letters should be mailed to these people calling attention to the value of the fireproof garage and to the writer's ability to construct attractive fireproof buildings. Pamphlets and folders are available, describing various types of concrete garages and offering suggestions through attractive illustrations. A supply of these pamphlets can be obtained on request or at a nominal cost[2]; one or more should be sent with the letter. A return postal to make reply definite and easy should be enclosed. A prompt personal call following a response should be made and so far as time permits personal solicitation should follow all letters whether or not a reply is received.

In making calls the builder should carry as large a collection as possible of pictures showing garages of the kinds he is prepared to build. This collection should be, preferably, good photographs attractively mounted in a neat album, showing his own work, but may be supplemented by photos from other sources and by pictures clipped from magazines, etc., and by bulletins.

Fortunately the floor plans of most private garages are extremely simple; attractiveness and fireproof construction are the strong selling points. Study the site and the owner's tastes. Most automobile owners are able to spend a little more money to buy an especially pleasing building.

For a single car, garages are frequently built 13′ x 24′, which gives a 3-ft. space around a large car and room for a small bench· This size can be reduced, where space is not available, to 12′ x 20′, which is small enough. The owner can often be shown the wisdom of building a two-car garage even though no immediate need exists. This will provide for a visitor's car or the space can be rented. The extra cost is not great. A good two-car size is 23′ x 23′ inside, but this can be somewhat reduced.

CONSTRUCTIONS

Concrete garages may be classed in three types as to construction and finish: (1) stucco on block, tile or metal lath, (2) block and other units, (3) poured or monolithic construction. The order given probably indicates the relative numbers of each type built.

Stucco Garages—The illustrations, Figs. 1 to 12 and Fig. 20 show stucco on a variety of bases. Fig. 1 is a very high-class building with living quarters for employees and with a greenhouse in connection. Above the foundations the walls are constructed of hollow tile which were filled with concrete and reinforced at all jambs and every place along the walls that received concentrated loads. Interior partitions are built of hollow tile. The second floor is of Floretyle[3] construction with a wood roof and suspended ceiling on rib lath.[3] All windows, sliding and swinging doors

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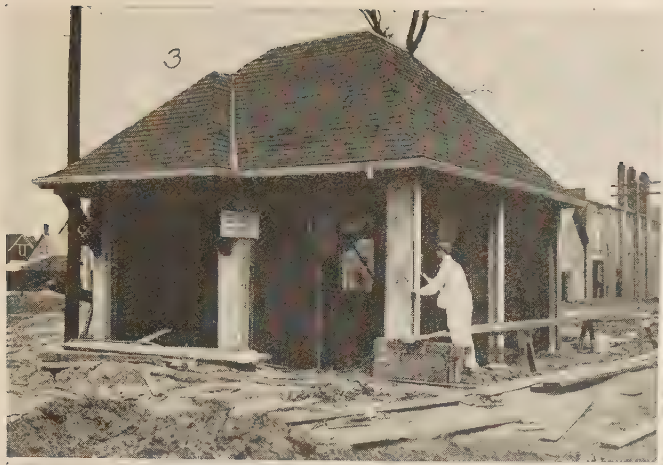
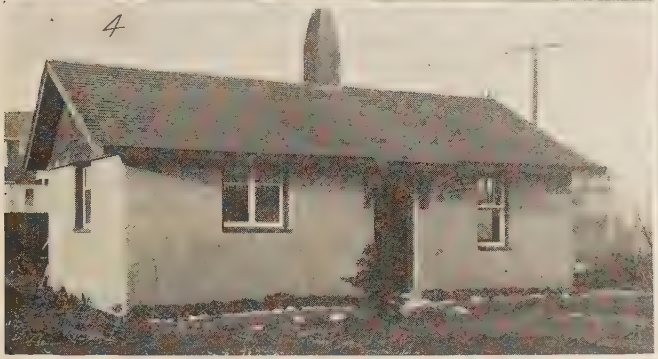
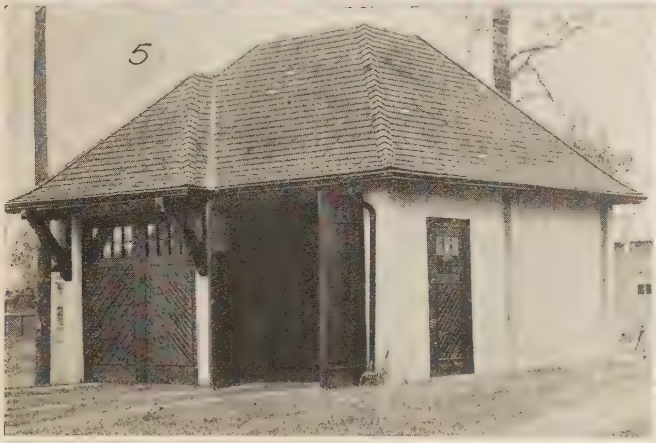
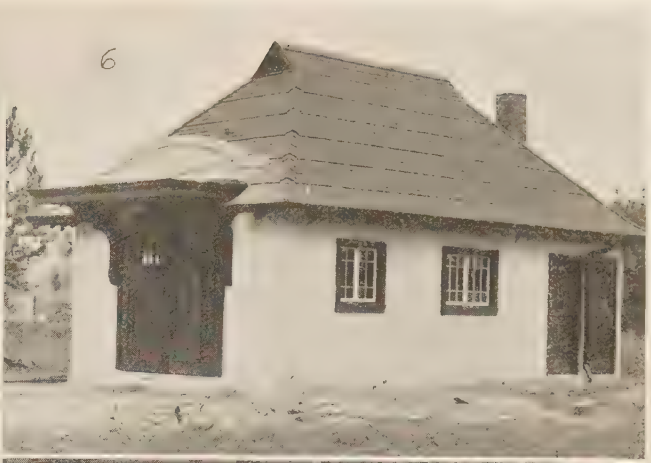
[1] From Concrete, June, 1916, p. 243

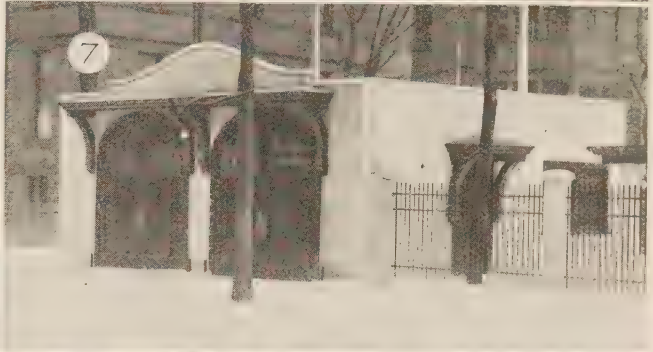
[2] Portland Cement Assn., 111 W. Washington St., Chicago; Alpha Portland Cement Co., Easton, Pa.; Atlas Portland Cement Co., 30 Broad St., N. Y. C.











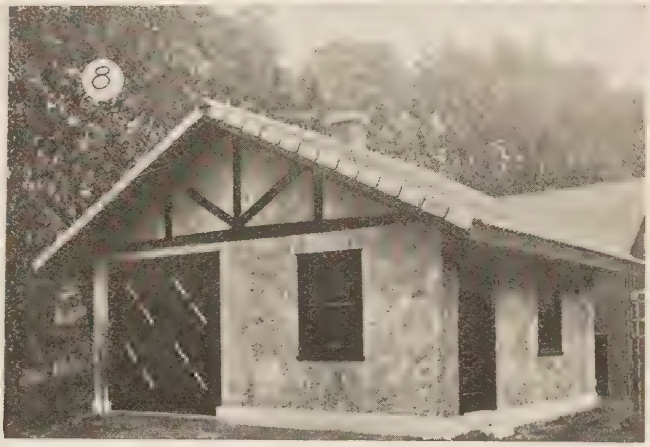


Fig. 3—Poured Columns with Metal Lath and Stucco
Fig. 4—Garage and Studio of Concrete Tile and Stucco
Fig. 5—The Garage Shown in Fig. 3 Complete

Figs. 6 and 7—Suggestions for Door Treatment; a Flat Roof is Economical
Fig. 8—Rough-Cast and Tile

are of United steel sash[3]; wired glass and fireproof putty were used, the entire interior is painted with Asepticote,[3] excepting portions of the bath room where Marine enamel[3] was used.

The garage illustrated in Fig. 2, while a monolithic building, is finished with stucco and is described by the builder, W. W. Schouler[4] as follows:

> The garage is 30′ x 20′, with living and storage quarters on second floor. First floor and second floor are of reinforced concrete. The first story is built of hollow monolithic walls consisting of two 4-in. walls with a 2½-in. continuous air space. The walls are holding 10′ of bank on two sides. Three hundred feet of retaining wall were built in the same manner, without forms, using a hollow wall machine.[5]
>
> The second story is of stucco on frame. The inside is plastered with patent plaster. Gas tank pump, work bench and electric lights are installed. Woodwork is stained dark and leaded glass windows are used. The second story was given a scratch coat and the entire building received a coat of stucco to get an even surface; then it was dashed with a mixture of 1 white cement, 2 sand and 3, ½-in. trap rock thrown on with brick trowel and paddle. Steam heater is in separate room, with outside door only.

Stucco on Lath—In Fig. 3 is shown a garage under construction, using poured concrete bearing posts with curtain walls plastered on Hy-Rib.[3] The finished building is shown in Fig. 5. The building shown in Fig. 4 is a combination building which faces the owner's garden and house. The entrance is into a studio which is separated by a fire wall from the garage proper, which is entered from the alley at the rear.

A large, rough stone fireplace with concrete mantel and chimney is an attractive feature. This building is constructed of hollow concrete tile[6] covered with stucco, and left unfinished inside. The roof is shingled and stained a dull red. A hot water heater is installed in the studio.

Illustrations 6, 7 and 8 are other

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[3] Trussed Concrete Steel Co., Youngstown, Ohio

[4] Schouler Cement Const. Co., Newark, N. J.

[5] Van Guilder Hollow Wall Co., Rochester, N. Y.

[6] Delta Brick & Tile Co., Detroit

Figs. 9-10—A Shelter Only, But Fireproof, Clean and Inexpensive

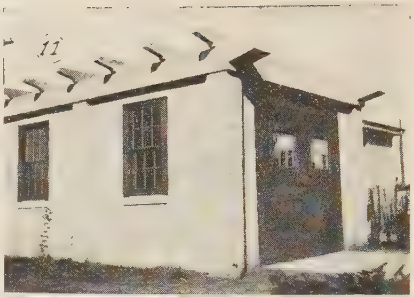
examples of metal lath and plaster construction. A number of methods are available for this work which is shown in its simplest form in Fig. 9. A frame of pipe, light angle iron or pressed steel lumber is erected and ribbed metal lath wired to the frame. Four coats of mortar, two on each side, should be supplied, making a reinforced slab about 2″ thick, and a third coat dashed or troweled on as an exterior finish. Similar construction on wood frame is much used but is not desirable for garages.

A garage built and owned by Louis R. Williams, Bartlesville, Okla., is shown in Fig. 11. The walls are brick, 4-in. curtain walls being used. The building is 14′ x 20′, 9′ to under side of reinforced concrete roof beam.

The longitudinal beams are 8″ x 12″ in section and overhang the stucco 1″. A longitudinal beam helps support the 3-in. concrete slab roof which is dished to the center and slopes to an outlet at the rear. The cross-beams that give the pergola effect are 4″ x 8″.

The poured work was finished by brushing to expose the aggregates and the brick plastered both sides and the exterior pebble-dashed. Gas and water connections and electric lights are provided. Cost, $185.

City requirements are resulting in the erection of a large number of gasoline stations. Fig. 12 shows an attractive filling station at Los Angeles, Cal. The Mission architecture has been worked out in stucco and furnishes a valuable suggestion. A feature is the installation of the



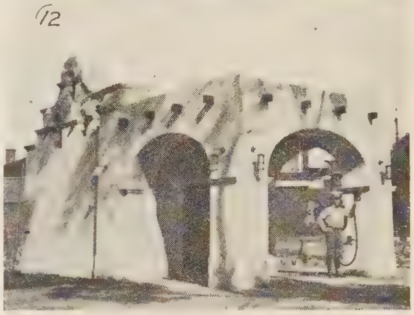
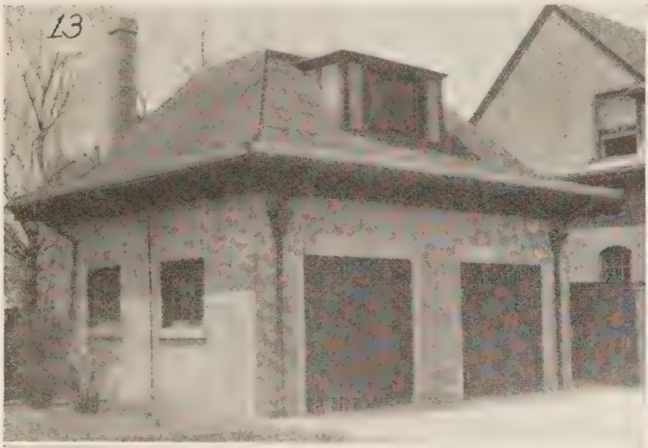
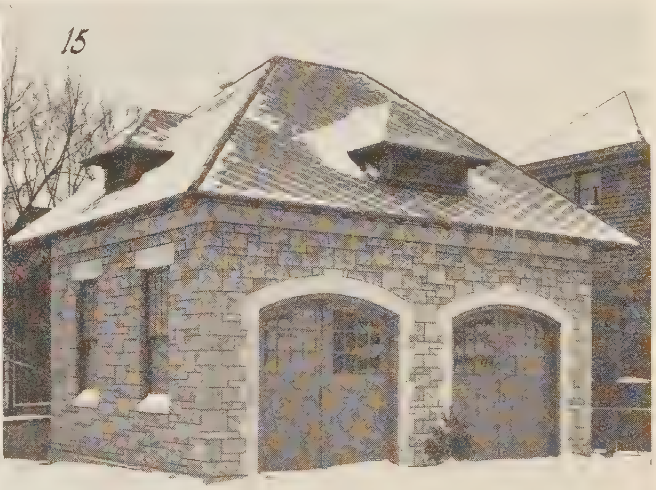
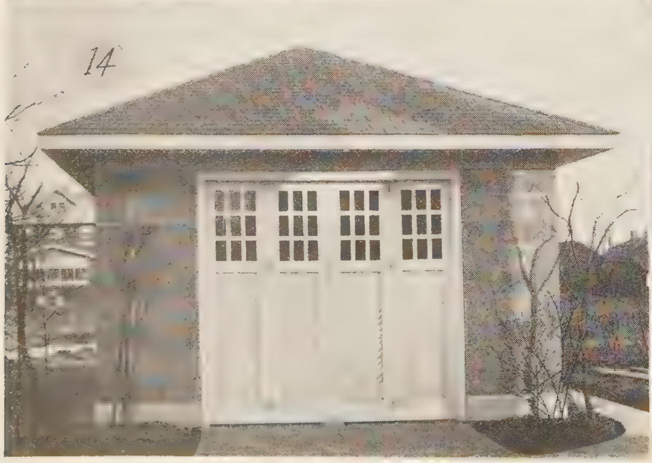


Fig. 11—A Rugged Building of Distinctive Design

Fig. 12—Mission Architecture Makes a Gasoline Station Beautiful







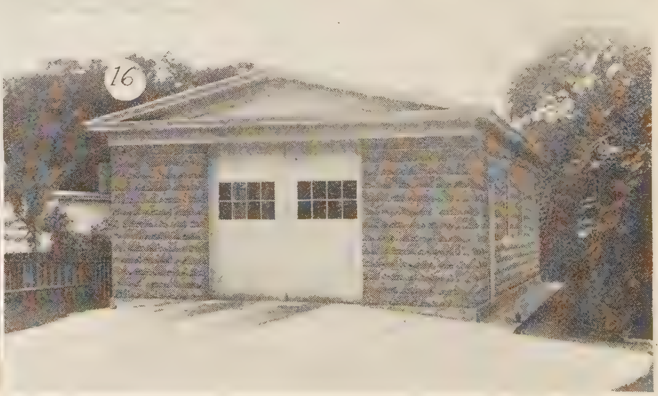


Fig. 13—Large Units and Tile Make a Dignified Building

Fig. 14—Plain Block in Two Tones

Fig. 15—Ashlar Laid Block, Careful Design and Good Work

Fig. 16—A Dignified Design; Plain Block Would Give a Better Effect

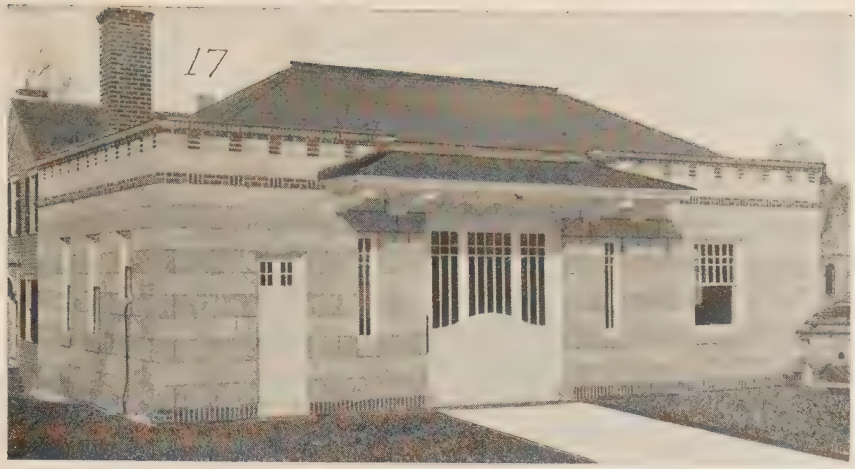


Fig. 17—Plain Block with Brick Trim; Work Like This Makes Friends

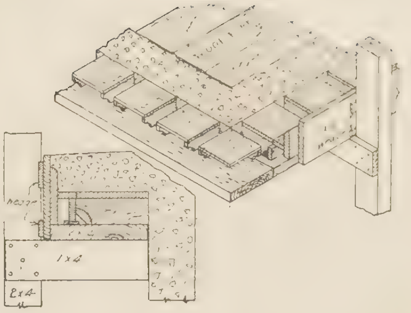


Fig. 21—Section and Isometric Views, Showing Form Details for Cornice

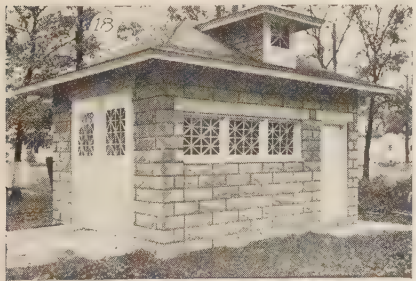
gasoline pump in one of the massive columns at the front.

UNIT CONCRETE GARAGES

Concrete units when well made and carefully finished make an excellent construction for a garage. Fig. 13 shows garage of plain-faced slabs built by W. E. Wagner, Toronto, Ont. The construction is very light and strong. It consists of thin concrete slabs set on edge and tied by concrete studs 2½" x 6", poured in place. Slabs are reinforced with wire mesh and left with a rough texture. These units have the effect of very large block. The roof is of metal tile.

A similar effect is shown, secured by the use of a rough-textured plain-face block,[8] in Fig. 14.

Other excellent examples of block garages are shown in Figs. 15 to 19. Fig. 15, laid in broken ashlar masonry, is an excellent example of the work being turned out by modern equipment[9] in the hands of expert workmen.



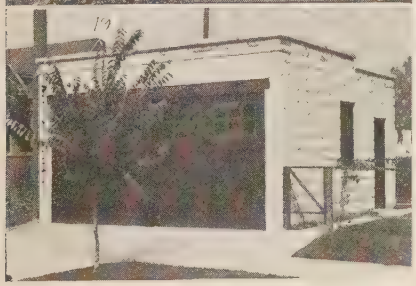


Fig. 18—Skillful Window and Door Treatment Makes This Distinctive at Little Increase in Cost

Fig. 19—Plain and Substantial Concrete Roof

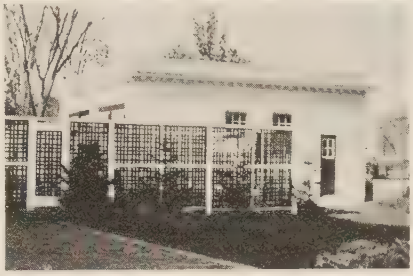


Fig. 20—All-Concrete Double Walls with Cornice Cast in Place

The building in Fig. 16 shows a roof treatment that adds dignity and finish to a plain structure. The pretentious garage, Fig. 17, shows an effective use of plain block and brick trim. Illustrations 18 and 19 offer further suggestions. Fig. 19 shows a concrete roof.

MONOLITHIC GARAGES

A very tasteful garage is illustrated in Fig. 20, which possesses the distinction of being truly all-concrete.

The garage, 36' x 42', was built at Brookline, Mass., by the F. O. White Const. Co., Cambridge, Mass. The walls are double, constructed with a hollow wall machine.[5] They were built up to the roof level and forms for a flat roof were placed; the cornice and its construction are shown in Fig. 21. The roof is 5" thick, reinforced with ⅝-in. rods 6" o. c. transversely and 24" o. c. longitudinally. A steel beam also sup-

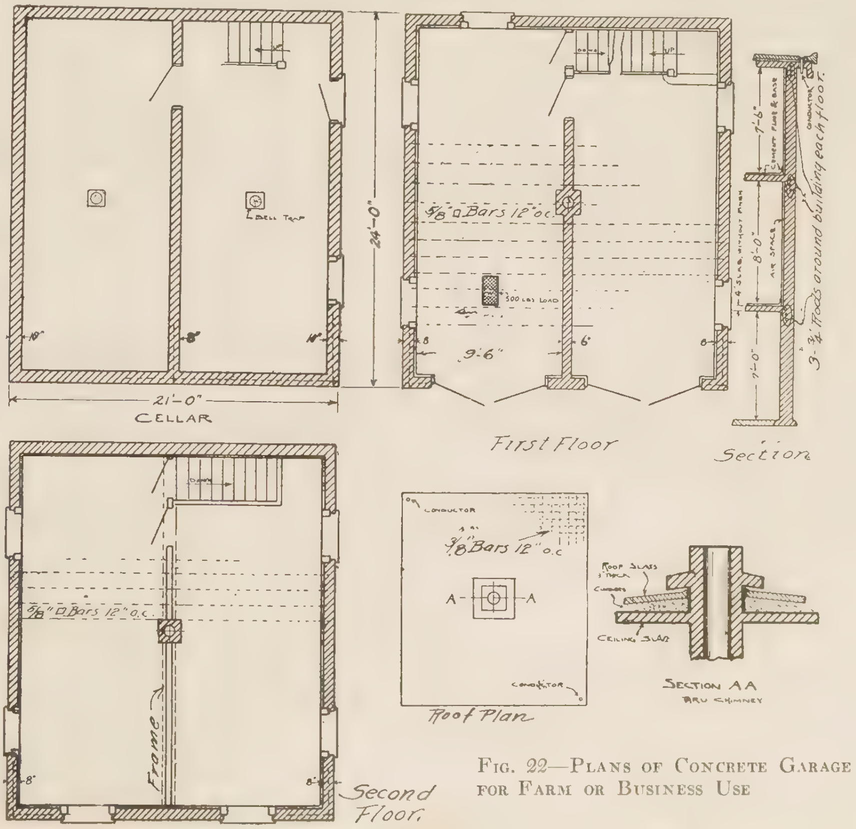


Fig. 22—Plans of Concrete Garage for Farm or Business Use

ports the slab at its center longitudinally. The cornice forms are supported by poles and ledgers. The poles are securely tied to the building. A 12-in. plank forms the base on which open-end boxes are laid at suitable spacing. These boxes are held securely by a molding and strips which form the end of the bracket and insure perfect alignment. The remainder of the form is clearly shown. After pouring the roof and the cornice, the parapet wall was built with the wall machine. The box forms should be made slightly wider at the bottom and the corners rounded. Forms should be well oiled with paraffin oil.

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[8] Hydro-Stone Co., Chicago

[9] Hobbs Concrete Machy. Co., Detroit

At times it is desirable to combine other buildings with the garage.

Fig. 22 gives plans for a two-story and basement garage designed for a Pennsylvania farm by A. Morgan Smith.[10] The building is located in a bank so that the basement is accessible from a low level. The building is 21′ x 24′ and was poured in wood forms.

The floor slabs were designed for a load of 150 lbs. and were tested by placing the weight at W; no deflection was noted. The slabs are 4″ thick, made of cinder concrete, reinforced with 5/8-in. square bars 12″ o. c. A 1-in. granolithic finish was placed for a wearing surface.

The building was furred and lathed to secure insulation and the outside walls were stuccoed. The roof is a 3-in. gravel concrete slab reinforced with 3/8-in. rods 12″ o. c. both ways. The concrete roof rests on a cinder bed entirely clear from the ceiling slab. The chimney was poured around an 8-in. stovepipe. The two floors give about 1,300′ area and the cost was about $1.00 per sq. ft.

A Cooling Room For Farm Use

A cooling room for farm use, as built by A. Farragut, contractor, Pascagoula, Miss., is proving of great benefit to the farmers in his locality. It is a timely suggestion to the farm contractor. The illustrations show plainly the size and the design of the building, which can be varied to suit requirements.

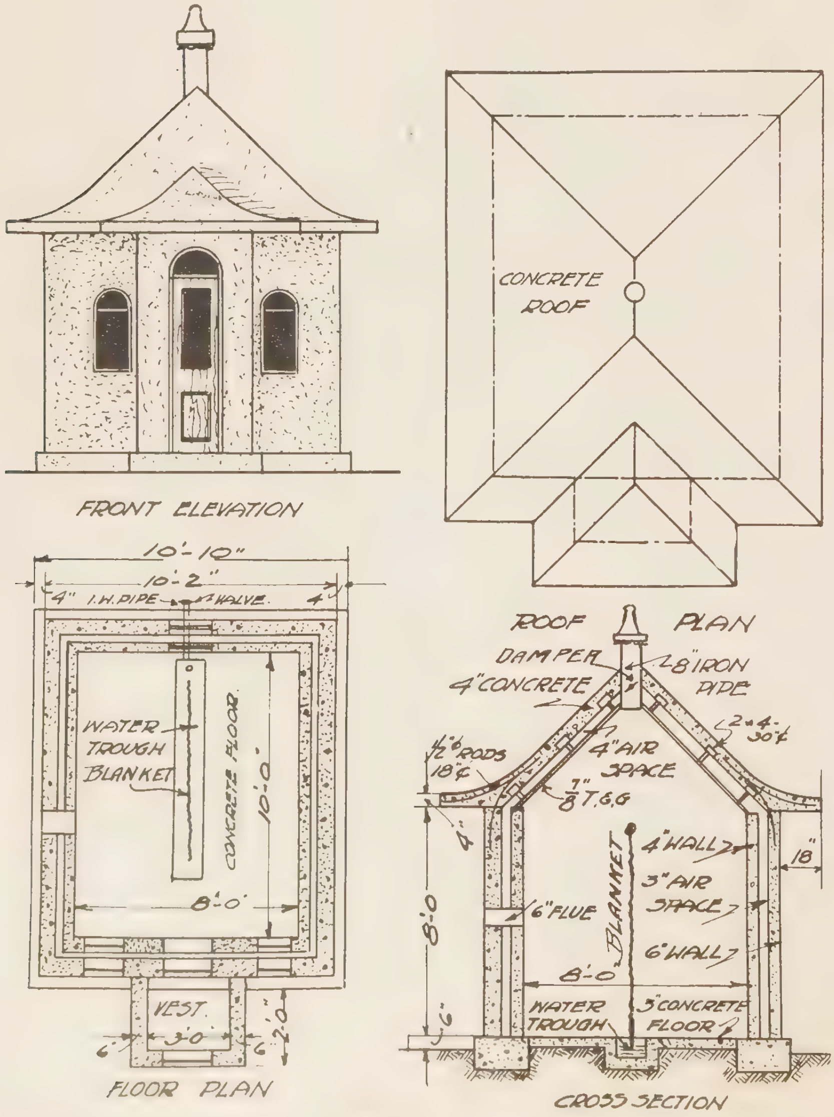
The secret of the building's success depends on a double concrete wall, which assures a very high degree of insulation. This air space should be continuous and be perfectly sealed.

In the construction of this building a hollow wall machine[1] was used, building the wall simply and economically. A double wall of block or even metal lath, plastered, would give similar results. A simple cornice and roof form was placed and the roof cast as shown, with provision for attaching furring and metal lath to give air space in the roof.

The cooling is effected by leading a stream of cold spring water through the trough cast with the floor and suspending a blanket with its edge touching the water, as shown by the illustration. The cold water is drawn up by capillary attraction and evaporated, reducing the temperature.

A ventilator with a damper is provided as shown to dispose of excessive dampness.

In early spring, when not needed for cooling, the building is an ideal incubator house, as it holds a constant temperature.



Plans of a Cooling Room for the Farm

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[10] Archt., Mt. Lebanon, Pa.

[1] Van Guilder Hollow Wall Co., Rochester, N. Y.

Block Cottages, Plastered Direct, in New Zealand[1]

W. D. Cowperthwaite, of the Cowperthwaite Concrete Block Co., Auckland, N. Z., sends some photographs from which the accompanying illustrations of a small concrete cottage were made. The cottage is built of 8-in. hollow concrete block for outside walls and 3-in. concrete block for partition walls, all made on an Ideal machine.[2] The concrete was mixed in a Little Wonder mixer.[3] The roof of the cottage is covered with concrete tile made on a Champion machine.[4] The base of the house below the first floor level and the top edge of the porch steps rail were painted with Glidden paint.[5] The ceilings are lathed with Oregon lath and plastered with pulp plaster. All these items of equipment and materials came from America and in addition the wall paper also. The cement used, however, is a New Zealand cement.[6] The stucco was waterproofed with Medusa.[7]

The Cowperthwaite Concrete Block Co., does not make any face block. Practically all the work it does is for walls which are to be stuccoed. On another page is shown an illustration of a handsome residence costing about $20,000 built for E. E. Langguth, formerly Austrian consul in New Zealand. The house is built of concrete block with plastering applied direct to the inside block surface. Inasmuch as Mr. Cowperthwaite is a strong believer in plastering directly on the interior surface of the block he makes frequent use of a testimonial letter from E. Langguth, in which Mr. Langguth says:

> The house you built for me in hollow concrete block has given every satisfaction. I consider the material far superior to ordinary brick and my reasons for saying so are that the walls are absolutely dry from top to bottom. The plaster is perfectly free from even the slightest cracks and in addition shows a beautiful finish. I conscientiously recommed your block as one of the cheapest materials for building houses in our damp climate.

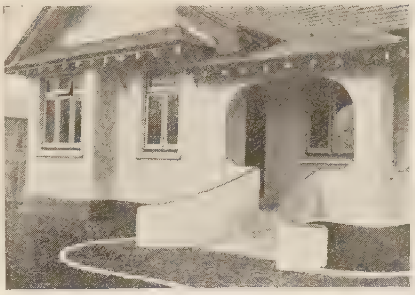

Fig. 3—Detail of Entrance Porch

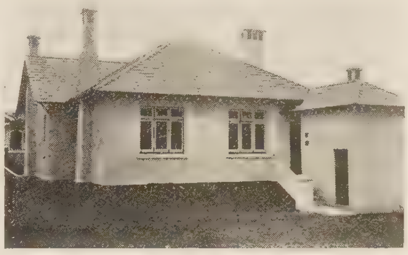

Fig. 2—Rear View Concrete Block Cottage

In this connection Mr. Cowperthwaite writes:

I have no intention of advocating porous concrete for monolithic work, seeing that it carries so much in requirements; at the same time porous concrete would not be more porous than the brick made here and can certainly be made stronger and much cheaper when in position at the same porosity. While at this time I am devoting all my attention to concrete block work, I built my own house with steel forms.[8] The walls are 8″ thick and the concrete is of a porous character, with only a waterproofing wash on the exterior wall. It is papered direct to the inner wall without plaster and is a success, as no dampness ever comes from the outside and we have no condensation on the inside. Before papering the wall I had a heavy felt paper put on first and then the wall paper. It was an experiment but is all right.

If the block are made 1:7, machine-mixed, all the strength necessary will be there, with sufficient porosity to attend to all moisture from the air, so that condensation is avoided. The outside can be easily attended to and penetration overcome. Our hardest problem is to avoid condensation and it can be managed only by having a wall that will absorb moisture. Cement plaster should never be used in dwelling houses for interior work. It is not porous enough. By cement plaster I mean what is ordinarily specified by architects as 1:3 mix. This is a dense material.

My ideas and methods are a little unorthodox and *unless carried out very faithfully would not be likely to prove successful.* With me they are very successful, having been able to carry out my ideas unhampered by restrictions of architects, so that it has been possible in a few years to determine whether I was right or wrong. So far I have not had a suspicion of failure and as my tests have been continuous for 5 yrs. it may be taken for granted that until I hear something that appeals very strongly to me, I am likely to remain unorthodox.

My first block, made 9 yrs. ago, were “dense”—“dampproof”—“weather-proof”—“correctly proportioned” and strong enough to carry a locomotive. These were faced block, “rock” and “plain,” the face mixture being 1 cement to 2 sand. Theoretically, they were “the thing,” and were, I think, as nearly perfect as block are ever likely to be, some samples of them being still on exhibition at a cement company’s office to show what can be done with cement and aggregate suitably proportioned.

An old proverb says: “The proof of the pudding is in the eating,” so the test of all concrete block is in their use. Different qualities of block must be used for different purposes.

The first block made were used in building a house for the manager of a local cement company, a photograph of which appeared many years ago in *Concrete,* sent by the then manager, Mr. Greer, who spoke highly of the result. The next were used for an Oddfellows’ Hall, which to some extent was in public use. In addition to dense block, the architect had the interior finished in cement plaster, the effect so far, as condensation is concerned being easily imagined. As our climate is very moist, at times little streams would race down the walls. A little of that decided, or at any rate seemed to decide, the fate of hollow concrete block; at any rate, it was a decided set-back. A demonstration was given to prove that the block were “water-tight” or “dampproof” (the question of strength was never in dispute) by having a well built on the ground in the block yard, the mason representing the public chosing any block he liked in the yard. The bottom of the well was cemented, the faces of block being left out, while the backs of block were left unplastered. The well would measure about 2′ x 2′ and 2′ 8″ high. It was filled to the brim with water, and stood there for a long time, being under very careful observation. At no time did we ever find a leak from the inside of the block, the only loss being by evaporation. This proof was accepted as conclusive so far as the “density” and “dampproof” qualities were concerned—but, the wall showed condensation on the walls, so it was considered too risky to build dwelling houses with them in this climate. There are always those in any community who are “in opposition.” We had them here and for a time they had a triumph. Fortunately for humanity’s sake, we get a few level-headed men mixed up with them or stagnation would result. One turned up at this time, and most fortunately he made no pretense to be an authority on concrete—or concrete block; he was willing to reason matters out, the result being that he left an order for sufficient block to build a house. Block were to be 1 part cement to 7 parts gravel, and to be left in yard “till called for.” Now, who expects concrete block of 1:7, without any pretense at waterproofing them with lime—or anything else—to be dampproof? As a matter of fact they would make good filters. These block were used to build a house that gave every satisfaction, although it was plastered directly on the block on inner walls. It must be noted that all my work has been in a moist climate, no frosts worth mentioning, and no snow. At the same time I would not anticipate much trouble in a colder climate. Special conditions might have to be provided for, which, it seems to me, might easily be done.

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[1] From Concrete, Jan., 1916, p. 16

[2] Ideal Concrete Machy. Co., Cincinnati

[3] Waterloo Cement Mach. Corp., Waterloo, Ia.

[4] L. Hansen & Co., Kansas City, Mo.

[5] Glidden Varnish Co., Cleveland

[6] Wilson’s Portland Cement Co., Ltd., Auckland, N. Z.

[7] Sandusky Portland Cement Co., Cleveland, Ohio

[8] Blaw Steel Const. Co., Pittsburgh

The next two orders came for block for house building, one of which was leaky through bad workmanship in laying the block. This mason claimed to know all about them, as he had laid them in America. He made the biggest mess of the lot. In these cases I only manufactured the block, architects and owners arranging and supervising the work to suit themselves.

So far there has not been the slightest satisfaction in supplying blocks to builders, nor had there been any in following out the instructions of so many learned experts on concrete on how to make hollow concrete block. All sorts of aggregates — sandy gravel, sand only, crushed rock, pumice, scoria of various kinds, had all been experimented on and good block made from all. By good, I mean as regards strength, for with pumice—and some kinds of scoria—it would be practically impossible to make a watertight concrete.

It was at this point that I decided to build a house of hollow concrete block, which should be plastered directly onto block on the inner walls, and stuccoed on the outside.

The result was not only an improvement on anything that had been done, but the building was almost perfect so far as weather-resisting qualities were concerned. The only points of failure were at two or three window angles, where a little damp crept in under the sill of frame. There has never been the slightest suspicion of condensation in any part of the house.

Since then I have built several, in which stricter supervision eliminated the weak places mentioned, the result being not only what was anticipated, but really all one could wish. Walls are plastered on the outside and finished in rough-cast, all inside plaster being applied directly to the block, and *in no case does condensation take place,* nor do the walls permit our terrible northeast rains to penetrate. I had the satisfaction last week of being commended by the authority mentioned, when he said: "I am convinced now that your method is the proper one for house-building."

While I am writing this we are experiencing a "northeaster"—wind and rain—that seems to get into the marrow of one's bones. For a week the atmosphere has been laden with moisture, and for 16 hrs. it has been steadily driving. If any condensation would show at all it should be now. To test the walls I have at this moment thrown three half-pints of water onto the bathroom walls, one on top of the other in quick succession—and the merest trifle has reached the floor. The wall absorbed the rest.

Now, which condition is more likely to provide a healthy house, "a dense wall" or a "porous wall," provision being made so that the outside wall surface is so protected that it is practically impossible for the weather to penetrate this covering?

[*Editorial Note*—The reader should not fail to note that Mr. Cowperthwaite is not contending with the conditions which favor interior condensation. A hard driving rain is a test of a wall's waterproof qualities, but it is not a test of the qualities which prevent interior condensation. Cold weather outside (not wet weather), with warm, moist air inside provides the conditions which test the insulation of a wall against condensation. The extremes of temperature of the northern part of the U. S. provide much more serious difficulties than those with which Mr. Cowperthwaite contends.]

House Built in Auckland, N. Z., for E. Langguth

Cracking and Discoloration in Sand-Finished Stucco Surfaces

Checking and cracking of a sand-finished stucco surface can be minimized by careful attention to details but discoloration is a matter which it is harder to overcome. It is a far more difficult matter to prevent discoloration on sand-finished surfaces than on surfaces which are given a rough-cast finish. The latter can be applied rapidly enough to complete the whole side of a house in a day's time and when once applied, needs no further manipulation. A sand finish, on the other hand, requires more time and smaller areas must be gone over in obtaining the proper texture, so that the chance for discoloration is greatly increased. Although much depends upon the use of a properly proportioned mixture, the result is largely a matter of manipulation. A great deal depends upon the skill and thoroughness displayed by the workmen. The manner in which the workmen trowel the surface will influence the color. Sometimes different shades may be seen similar to those noticeable on the surface of a newly completed sidewalk, half of which has been finished from one side and half from the other.

Overworking and overtroweling of a sand finish will bring too much of the fine material to the surface and, as in the case of sidewalks and floors, will cause trouble through checking and cracking. Over-richness of mixture is another cause of trouble and we believe that for a sand-finished stucco surface, the finish coat should generally be mixed in proportions of 1 sack of cement to $2\frac{1}{2}$ of fine aggregate.

One experienced plasterer has suggested that when the finish has been applied, floated and troweled, the workman go over the surface after the finish has begun to harden, using a float covered with soft carpet or felt, in order to even up the appearance of the wall both as to texture and color. In this way he believes surface checking can be overcome, and the chance of discoloration greatly lessened.

Hot sun or winds produce rapid drying of stucco surfaces, which results in checking to a considerable extent; under such conditions the surface should be protected by hanging wet blankets in front of the wall and keeping them wet for several days, or by spraying the wall with water frequently after it has hardened sufficiently to prevent injury.

Furring Walls and Plastering Direct[1]

DISCUSSED BY:
HARVEY WHIPPLE[2]

"In residence construction should plaster be applied direct to interior surfaces of walls?"

This magazine has always advised its readers not to plaster direct on the inside of any residence wall which does not provide a continuous air space. This advice has been given repeatedly in spite of apparently successful house construction where plastering has been applied direct to the interior surface. Good results *have been* obtained not only on hollow concrete block where the hollow space is not continuous but also in solid concrete walled houses. This magazine has adhered to the idea that dry walls can not be made a certainty without a continuous air space such as is provided either by a two-piece block or by a double wall of monolithic construction or by furring. There has always been a feeling of hesitancy in pointing out that very successful work has been done where plastering has been applied direct to walls without the continuous hollow space, because it seemed that success could not be *assured* although it is *possible* with the more economical type of construction.

DAMP WALLS

In the early days of concrete house construction, particularly in the use of concrete block, altogether to much reliance was placed upon the fact that most block had a hollow space equal to 25% to 50% of the horizontal area of the block. It was believed by many builders that this partial hollow area in the wall would take care of insulation and to some extent take care of penetrating moisture and make it possible to plaster direct on the interior surface. The result was many failures and this magazine is still receiving letters every little while from owners of or residents in concrete block houses which have damp interior wall surfaces. These failures, however, proceed from two causes and the two causes are absolutely distinct and different. One is the penetration of outside moisture, the other is the condensation of inside moisture. One failure is caused by block which are very poorly made of materials not properly graded so that moisture is admitted *through* the solid webs. Then again, a perfectly good block may be poorly laid up so that water gets in through the joints and this appears on the interior plaster when the plaster has been applied without furring. Further difficulties are sometimes encountered even when block are well made and when well laid up, providing there are settlement cracks or cracks developing through other faults in construction, through which moisture is admitted. The other trouble is encountered even with the best of walls when ventilation is poor or when there is no air space. All of these conditions, commonly encountered in work not properly done from start to finish, have contributed to the position of this magazine in maintaining that the surest way is to fur out on the inside of the ordinary block wall before applying plaster.

CONDENSATION

The admission of moisture from the outside of the wall to the inside of the wall, either through porous block or through cracks, is an entirely different matter, however, from the condesation of moisture on the inside of a wall which may be perfect in every respect. The solid webs of the block communicate temperature changes from the outside of the wall to the inside of the wall so that if there is a great amount of moisture on the inside of the house, as there frequently is in the winter time when the ventilation is not so well taken care of there is condensation of the moisture from the warm air inside on the cold surfaces of the block.

SUCCESSFUL WORK, PLASTERING DIRECT.

While it is not the intention of this magazine to recall the advice which it has given it does seem important to call attention to certain developments in the use of concrete block whereby very satisfactory results have been obtained with plastering applied directly to the interior wall surface. This has been accomplished successfully where precautions were taken that no moisture could get through from the outside to the inside. This is commonly done by covering the outer surface with a thoroughly waterproof stucco which seals up all the pores and the cracks and prevents any moisture penetration. As to interior condensation, it is undoubtedly true that if ventilation is well taken care of in the house so that there is a change of air on the inside there will be little danger of condensation on the interior surfaces due to any lack of an insulating air space.

EXPERIENCE WITH UNFURRED WALLS

In the Jan., 1915, issue in connection with the description of houses built by the Sage Foundation Homes Co., at Forest Hills Gardens, Long Island, there was mention of a cored slab used for the walls. These slabs did not supply a continuous air space in the wall but did provide flues not unlike the flues which result from the construction of walls with ordinary hollow concrete block. It was said that there had been no trouble from condensation of moisture on the inside of these walls except in the kitchen in the winter time when the air outside was cold and when there was an unusually large amount of moisture inside due to some kitchen work which provided the unusual conditions.

A further instance of successful work along this line appears to be in the houses erected in England, mentioned on another page. These houses are built of concrete block covered with stucco on the outside and with plaster applied directly to the block on the inside. In making these block there was no attempt to obtain a thoroughly dense block to shed water. The absorption was taken care of by providing on the outside a seal coat of plaster and then a rough-cast coat and these two together are depended upon to prevent the penetration of moisture. The strongest evidence, however, of successful work along this line with plaster applied direct to the interior surfaces of block walls is supplied by W. D. Cowperthwaite, Auckland, N. Z. Mr. Cowperthwaite makes no point whatever of trying to get a thoroughly dense block. He says that a block which is not of the densest, most impermeable concrete actually gives better results in the construction of houses in which the the plaster is to be applied direct on the inside. These houses are stuccoed very carefully on the outside in order to prevent absorption.

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[1] From CONCRETE, Jan., 1916, p. 36

[2] Editor, CONCRETE

W. F. Schwieterman, gen. mgr. of the Cement, Tile & Block Mfg. Co., Osgood, Ohio, writes that while he has bulit a great many concrete block houses which were furred on the inside before lath and plaster were applied, he build a house for his own occupancy in which he plastered directly on the block. He says that this construction is not only cheapest but the house has given the best of satisfaction. He says that the walls are perfectly dry and that the only condesation to be noticed is in the kitchen when there is much steam in the room in cold weather. He accounts for this very properly by saying that it is because the room is practically air tight when closed up in the winter, something which is not true in ordinary flimsy construction. In other words, the tighter the house against ventilation the more apt there is to be condensation on the inside.

A FAILURE IN PLASTERING DIRECT

On the other hand William N. Ward, Mgr. of the Twentieth Century Concrete Block Co., Audubon, N. J., writes that houses of concrete block which he has bulit where no furring was used before plaster was applied have not been satisfactory and that the walls are damp. He says that this dampness is due to condensation and not due to absorption from the outside. This report is typical of hundreds of instances of poor economy in plastering direct.

Rolf R. Newman, Riverside, Cal., says that he has bulit solid wall houses in New England and in spite of a rigorous climate they have been entirely satisfactory with plaster applied direct on the interior surface of the wall.

All of the accumulated testimony bears out the belief that it is a somewhat complicated problem in which some of the conditions respecting each particular case are not always known. It also seems obvious that the tendency to experience trouble from condensation on the inside, when the wall itself is entirely satisfactory from a waterproof standpoint, is more apt to be met with in very cold climates than in moderate climates. Solid wall houses, for instance, in the vicinity of Washington, D. C., have been entirely satisfactory. Yet a type of construction satisfactory in Washington might prove entirely inadequate in a colder region. It would seem that if a builder is determined to plaster direct on the wall, his problem providing he has good materials to make a watertight wall of, becomes one of ventilation in order to prevent condensation. This situation might be much different with thicker solid walls, because increased thickness of wall obviously would overcome to some extent the tendency of the walls to present a cold surface to moisture on the inside.

William Mayo Venable[3] points out very positively that it is not safe in a cold climate to eliminate interior furring on any type of block wall except one having a continuous interior air space. In his opinion it is not advisable to put interior plaster direct on concrete block nor upon a solid wall unless the wall is more than 9″ thick. It is practicable he says to make walls thick enough so that they can be plastered direct on the inside but it is very expensive and the thickness required depends upon the climate as well as upon the composition of the concrete.

“POPCORN” CONCRETE

In this connection it should be mentioned that there have been suggestions of a so called “popcorn” concrete. Very porous concrete might be made with cinders and very little sand and while this would not be strong it would undoubtedly have a great tendency to overcome condensation and to provide, by its own porosity, the insulation which is ordinarily secured by means of a continuous air space. Houses built with something of this idea in view are those constructed at Nanticoke, Pa., by Milton Dana Morrill,[4] several years ago. It is urged, however, in this connection by Mr. Venable that such concrete does not provide proper protection for the steel used in reinforcing.

Mr. Cowperthwaite contributes the idea that a solid wall should not be plastered inside with a dense Portland cement mortar, on the theory that a certain amount of moisture is objectionable only when it is evident. A more porous plaster is recommended so that slight condensation will be absorbed. Such walls probably should not be painted so that the pores will be closed. Readers will be familiar with the fact that painted kitchens sometimes show a great deal of condensed moisture on the walls while a wall not so painted absorbs the moisture so that it is not evident.

To sum up these various ideas on the subject of providing insulation against temperature changes and waterproofness as well, in concrete walls it seems that the conservative builder, who wants to be sure of a satisfactory job, will either provide in his wall a continuos air space or else he will fur out before applying lath and plaster. Another builder equally conservative perhaps but with experience along other lines and feeling sure of the character of the work which he and his men are doing, may, like our correspondents in England and in New Zealand, find it very satisfactory to plaster direct on the block. When this is done, however, it seems necessary not only that ventilation be taken care of so as to prevent condensation but that the wall be structurally perfect, not only when first built, but for the future so cracks will not develop, which will admit moisture from outside. It is up to the builder to decide whether or not he is sure enough of his methods and of his men, to save the expense of furring and lath before applying plaster, by the most careful methods in every other respect in his work. The builder who is very sure of the character of work he is getting out of the men in his employ can do a great many things which builders cannot do who are not absolutely sure. Most builders will probably decide that if they are taking chances with solid walls, with no air space, they prefer to take the necessary precaution rather than assume responsibility for chances of failure. To sum up:

Dampness on the interior surfaces of concrete walls may be due to:

1. Poor concrete, which is so porous as to permit the moisture to strike through from the outside.
2. Cracks (caused by poor block laying, by settlement of wall or by temperature movement not properly provided for) through which moisture penetrates to the inside.
3. Lack of air space for insulation in the wall or lack of proper ventilation so that moisture in the air inside the house condenses on the walls.

The wood shingle has no equal as an agent in starting and spreading fire. Municipalities are beginning to realize this fact and to prohibit its use. In many sections at the present cost of singles and labor the saving over incombustible roofings is so little as to make the wood shingle of doubtful economy.

European countries are leading us in the use of concrete roofing tile, very likely because the shingle is unknown abroad and would not be tolerated by European ideals of safety and permanence.

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[3] Chf. Engr., Bldg. Dept., Blaw Steel Const. Co., Pittsburgh

[4] *Concrete*, Feb., 1912; CONCRETE-CEMENT AGE, Mar., 1913, p. 153, Apr., 1913, p. 173

Concrete Floor Construction for a Residence[1]

THE QUESTIONS BELOW ARE DISCUSSED BY:

CHARLES H. NEAL[2]

A. MORGAN SMITH[3]

W. E. WAGNER[4]

PROF. A. B. MCDANIEL[5]

"What, in your estimation, is the most practical and economical floor design for the house plan shown, taking into consideration the following conditions:

"1. An isolated house which cannot stand investment in expensive equipment.

"2. Ordinary labor, an intelligent foreman, willing to follow directions but not a specialist in this class of work.

"3. Concrete material; bank gravel of good quality.

"4. Reinforcement; any type procurable in open market."

[EDITOR'S NOTE—The floor plan selected for discussion is that of a house described in the Jan., 1916, issue, p. 3, and built by J. F. Hahn, C. E.

This plan was selected because it involves distinctly different spans and because its size and arrangement would seem to make it of general interest.

No criticism of Mr. Hahn's design is implied; in fact, a design practically identical with that actually used was submitted by two correspondents, but it is omitted to avoid duplication.]

BY MR. NEAL

If I were constructing the house in question I would put in simple slab floors 4″ thick of 1:2:4 concrete with $\frac{1}{2}$-in. to $\frac{3}{4}$-in. top or wearing surface, 1 part cement to 2 parts good sand and treated with some one of the good dust preventives on the market. If other than this finish were used I would probably make the base full 4″ thick, but in the case of the sand and cement finish would make it a part of the 4″, putting it on immediately after pouring the base, thus getting advantage of the strength in the compresive surface.

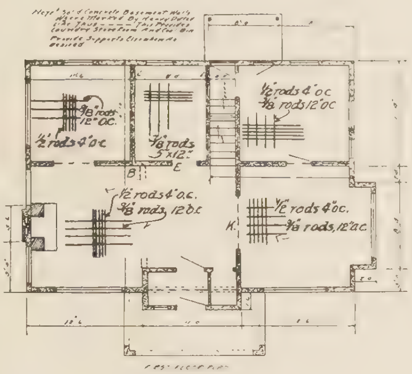
$\frac{3}{8}$" rods 12" O.C.
$\frac{1}{2}$" rods 4" O.C.
$\frac{3}{8}$" rods 5"x12"
$\frac{1}{2}$" rods 4" O.C
$\frac{3}{8}$" rods 12" OC
$\frac{1}{2}$" rods 4" O.C.
$\frac{3}{8}$" rods 12" O.C
$\frac{1}{2}$" rods 4" OC.
$\frac{3}{8}$" rods, 12" O.C
B
E
K.

FIG. 1—FLOOR PLAN

On the longer spans (13′ 8″) I would use $\frac{1}{2}$-in. bars either square, deformed or twisted, spaced 4″; and $\frac{3}{8}$-in. transverse bars spaced 12″. (See Fig. 1.) I would support these bars $\frac{3}{4}$″ from the forms by means of spacing chairs or supports placed at every square foot crossing and wiring the $\frac{1}{2}$-in. rods securely to the transverse rods. On the shorter spans $\frac{3}{8}$-in. bars would be used altogether, spaced as above only when the span does not exceed 8′. Under 8′ I would space them 5″ instead of 4″. To get a good safe job the spacing chairs or supports are indispensable, because they insure against getting the steel down on the forms, hold everything in its place and permit of rolling wheelbarrows on boards laid directly on the rods without risk of damage—especially where the pouring is rapidly done. The form would be made of a medium grade of t. and g. $\frac{7}{8}$-in. boards supported on 2-in. x 4-in. joists spaced 2′ o. c. with uprights placed 4′ to 5′ apart. If the concrete is carefully placed this will give a nice overhead surface which will need no further treatment except to rub out the form marks and kalsomine or paint as desired. A good grade of bank or creek gravel with the larger pebbles taken out will be all right for such work, provided the proportion of sand is not exceeded.

This work would require no great amount of skilled labor. A foreman of average intelligence willing to follow instructions, could with a force of ordinary laborers do the work. The lumber in the forms, if taken down with care, could be used for both floors.

To some designers such a floor as this may appear unsafe but the writer has recently had experience in floor construction which leads him to believe otherwise. I have now under way a concrete dwelling in which such a floor has been used.

The floor spans are 16′. At first I began to cast about for a suitable floor slab design and, wishing to economize in floor thickness, began to wonder whether or not 4″ would be safe for that span. I could find no formulas or tables that would allow such a thing nor could I find any case in which 4″ had been used in so great a span. I decided to make a test. A slab section 1′ wide, 4″ thick and 16′ long was made. The only available bars at the time were $\frac{3}{8}$-in. twisted. Three of these were put in the section. The piece was poured so that when the forms were taken out the ends would be resting on supports just 16′ apart. At the end of 14 das. the forms were removed and all of the supports except those at the ends were taken out. The slab deflected of its own weight about $1\frac{1}{4}$″. Two men weighing 150 lbs. each walked to the center and stood. It deflected then to about 3″ in all but showed no signs of failure. It was then raised back to a level position and left 7 das. longer. At the end of 21 das. the props were again removed and this time four men weighing approximately 150 lbs. each were placed in the center. The deflection was about as before but still there was no sign of failure except a few hair cracks that appeared on the under side between the outer edges of the section and the outer bars, which were about $1\frac{1}{2}$″ from the outer edges of the slab. I attributed this to there being no steel to prevent rupture at these points. I was, however, not entirely satisfied with the result and decided to stiffen my floors by running beams through the centres of the spans one way. This was done but since pouring and testing my floors I have decided that these beams were not really necessary and that if I had made my floors as described above they would have been sufficiently strong. That old test slab has been there all through the job, with everybody walking on it and jumping up and down at will. It springs like a hickory board, but so far we have not been able to break it down. It seems to improve with age and the deflection is less now than at the beginning.

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[1] From CONCRETE, Information and Consultation Dept., Feb. 1916, p. 84.

[2] Highway Engr., Asheville, N. C.

[3] Archt., Mt. Lebanon, Pa.

[4] Engr., Toronto, Ont., Can.

[5] University of Illinois, Urbana, Ill.

By Mr. Smith

Concrete floor construction for residence is suggested as follows:

Cellar wall (see Fig. 1 for references)—To be 10″ or 12″ thick; 3 ⅝-in. twisted square bars to run full length of front and back walls just over window heads. Not necessary to reinforce partition. Note "End of Cellar Wall" and connect across with beam at "E."

First floor slab—To be 5″ thick and reinforced with ⅝-in. twisted square bars 24′ 9″ long, spaced 12″ o. c. Beam "B" to be 8″ deep with three ¾-in. rods. Beam "E" to be 8″ deep with three ⅝-in. rods. Near cellar stair opening place three ⅝-in. bars about 5′ long.

First story walls—Three ⅝-in. square twisted bars to run full length of front and back walls over window heads and below second floor slab. Run three ⅝-in. bars through center partition over door heads and through beam "E."

Second floor slab—Thickness of slab and steel same as for first floor slab. Beam "B" to have three ¾-in. bars.

Second story walls—Reinforcing similar to first story walls. Partition "K" should have three ⅝-in. bars within 18″ of the floor.

Seventy lbs. live load on floors allowed. Concrete to be mixed 1:2:4, cement, sand and gravel. Usually for an isolated job, where skill is scarce, it is best to use heavier bars and space farther apart.

By Mr. Wagner

As economy is a vital question in the design of a dwelling of the type under discussion, the aim should be to secure fireproof qualities, using as far as possible the ordinary building materials, which can be easily procured, and methods which have been adopted from experience.

Reliable men can be found in any locality for ordinary building work, but when new methods are introduced considerable expert superintendence is required, to be sure of satisfactory results.

It is very pleasing to the engineer or architect to have every piece entering into a structure incombustible, but outside of this, very little gain is achieved in substituting fireproof material at higher prices for combustible material, which from its position and nature does not under any circumstances act as a menace to the building. The aim should be rather to make fireproof all such parts as are in danger of catching fire or of spreading it, or which could in case of fire cause serious damage to the building or contents.

With these things in mind the first step in designing a floor for a concrete dwelling is to get away from wooden joists which are in the most favorable position for catching and spreading fire. A close hardwood floor, tongued and grooved, if separated from wooden joists, is fireproof for all practical purposes, for a fire could burn on the surface for a considerable time without igniting it.

Even the ordinary lath and plaster ceiling will be almost as free from danger of fire as more expensive channel and metal lath ceiling, provided it is properly isolated by being attached to fireproof joists.

The design which I advise for floors in a moderate priced concrete house is reinforced concrete joists, with wooden floors and ceiling of lath and plaster, or standard fiber board, combustible in themselves but practically safe from fire for the reason that there is no place for fire to get a start, and affording no great danger to the house or contents in the event of fire starting due to some extraordinary cause.

Concrete joists on 16-in. centers made and set as shown will cost in place, exclusive of the forms, about 95 cts., or about $15 more than wooden joists.

If a number of houses are to be constructed the cost of the forms for the joists will be slight, for they can be used repeatedly and hundreds of joists can be made with one set of forms.

The house shown in the illustration will require 54 joists 2″ x 10″ x 13′ 6″ reinforced with ½-in. steel rods with projecting hooked ends, and 54 joists of same dimensions 10′ 8″ long. The steel rods in these might be lighter, but it will be more convenient to use ½-in. steel for all.

The illustration shows part of typical joist with nailing strips attached and the method of manufacturing the joists and the forms necessary.

CONSTRUCTION

On a suitable level floor set up and brace as shown the dressed plank A 1¾″ x 11⅛″ and 1¾″ longer than the required length of joist. At right angles to this set up and brace and planks B of same dimensions, and of a length dependent on the number of joists it is desired to make in one set.

The end planks are slotted to admit of the passage of the bent ends of the reinforcing steel, and have cleats C nailed in place as shown, the section of cleat c′ being removable.

Having placed a bent rod through the slots of the end plank, raise it, and hold it in position with the removable piece of cleat c′. Next place the bottom nailing strip D in which are bent nails for bonding into the concrete, and attach the steel rod to the nails in several places with fine wire to hold it central. Now put the separating board E into the grooves formed by the cleats C. Every third or fourth nailing strip might be lightly toe-nailed to take the spring out of the lumber and keep all the joints tight.

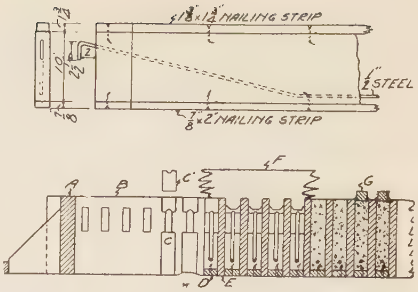

Fig. 2—Details of Form for Unit Joists

After the steel and the forms for the required number of joists are in place and the outside plank set and braced, put in several spacing plank F to keep the separating boards to line until the concrete is partly poured. The concrete should be brought above the top of the forms and the surplus struck off with a straightedge.

Now place the top nailing strips G, through which nails have been driven and bent. On the outside form planks place gauge strips ¼″ thinner than the height of the nailing strips, and tap with several heavy straightedges until the straightedges rest on the gauge strips. If necessary, tack them down to hold the joists true to depth until the concrete hardens.

The lumber for forms should be soaked in water before using to prevent swelling, and should be well oiled.

Concrete should be mixed in the proportion of 1 of cement to 5 of uniformly graded gravel, passed through a ½-in. screen.

In erecting the joists, first have the forms for the side walls up to the level of the bottom of the joists, and nail a girt along the inside of the studs to support the joists. After the joists have been placed in position, with their ends projecting into the wall space continue the form work around the joists and pour the concrete, tying the ends of the joists into the wall, taking care to place steel rods over all openings to form beams of sufficient strength to carry the floors as well as the concrete wall above.

By Prof. McDaniel

In consideration of the best type of floor construction for a small residence, the principal factors are cheapness, strength, weight and ease of construction. The first two conditions, an isolated house and ordinary labor, will require simplicity in design and construction. This result can best be secured by the use of a flat slab with a type of reinforcement which can be easily and properly placed.

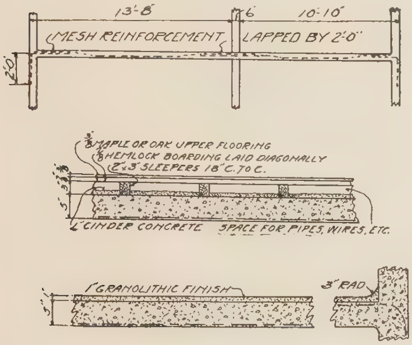
13'-8"
6"
10'-10"
MESH REINFORCEMENT LAPPED BY 2'-0"
2'-0"
⅞" MAPLE OR OAK UPPER FLOORING
⅞" HEMLOCK BOARDING LAID DIAGONALLY
2"x3" SLEEPERS 18" C. TO C.
5"
1" CINDER CONCRETE
SPACE FOR PIPES, WIRES, ETC.
1" GRANOLITHIC FINISH
5"
3" RAD.

Fig. 3—Floor Details Suggested by Prof. McDaniel

Two types of floor construction are adaptable to the conditions: the flat slab with a simple type of reinforcement and the one-way tile system. The latter type would be economical and light in weight, but the writer does not advise its use unless skilled labor is obtainable. Hence in this case, the writer would recommend a simple slab with a "mesh" type of reinforcement. Expanded metal unit high tensile wire fabric[1] or similar material such as rib metal,[2] is available, easy to place and efficient for light loads. This form of reinforcement should be placed with the long way of the mesh or the rib transverse to the supporting sides or parallel with the short dimension of the slab. In this case the clear span width of the living room, 13′ 2″, would govern the depth of slab, which could be made 5″ with the use of 0.35 sq. in. of reinforcement per ft. of width of slab. This design would be based on the use of a bending moment coefficient of $\frac{1}{10}$, assuming the slab to be fixed at the ends and continuous over the intermediate support. The illustration shows the method of placing the reinforcement (Fig. 3).

It is assumed that the concrete would be mixed by hand or with a small batch mixer. The proportions should be about 1:2:4 by volume, although a simple density test might profitably be made to determine the proportions which would give the greatest density with the material on hand.

The concrete should be transported from the mixer to the floor in steel wheelbarrows and shoveled into place, care being taken that the reinforcement is entirely embedded.

The formwork could be simply provided for by a system composed of 3-in. x 4-in. posts spaced about 7′ o. c. through the middle of the larger rooms. The posts would support 3-in. x 6-in. girts, which would carry 2-in. x 6-in. joists spaced 24″ o. c., on which the 1-in. x 6-in. roofers would be laid. Along the outside walls the ends of the floor joists would be supported on ledgers. The slab forms might economically be made up into sections, about 3′ 6″ x 7′, which could be used at least twice to advantage.

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[1] Am. Steel and Wire Co., Chicago, or Clinton Wire Cloth Co., Clinton, Mass.

[2] Trussed Concrete Steel Co., Youngstown, Ohio

Concrete Floors in Dwelling Houses and How They Were Finished[2]

A Letter from Homer Laughlin, Jr.[2]

To give you accurately my experience in living in a house with concrete floors, it will perhaps be well to go back a little way and relate my experiences which led to the adoptin of a concrete floor for a residence.

The Homer Laughlin building, which I own, was built in 1898 and was the fifth building in the U. S. and the first building west of Chicago to use concrete floors. These were concrete floors placed on a steel skeleton. At the time the building was opened I had grave doubts of its success because every prospective tenant brought up the subject of the floors. Either they themselves were affected by rheumatism or they had some one in their office who had rheumatism and they were quite sure that living in an office with concrete floors would be detrimental to their health. The common remark was that they could feel the chill of the concrete go through them the moment their shoes touched the floor. Although the prejudice was gradually overcome it was at least 5 yrs., when concrete floors in office buildings had become more general, before the attention of the public was attracted to other features and away from the concrete floors and I may safely say that it has been at least three years since I have heard a single person mention the subject.

When I was about to erect my home and decide on the subject of floors, my father, who had been a strong advocate of concrete floors in office buildings, advised me against their use in a residence. Careful inquiry developed that he himself was not opposed to the floors but was satisfied that my friends and others would interpose all the objections to their use in a residence that we had formerly gone through in our office building and so I decided to put wooden floors downstairs for the benefit of my friends and concrete floors upstairs for the use of my family; but finally we worked up one excuse after another for leaving the wood floors out of certain downstairs rooms and finally they were left out altogether.

My floors are of a warm brown tone and come up on the side walls about 6″ and flush with the plaster to form what would otherwise be a baseboard. Downstairs they are decorated with a pallette-knife and look somewhat like carved leather. After the "carving" had been done an artist worked various colors of the rainbow into the decoration and then they were all varnished and waxed so that keeping them in order is similar to the polishing of wood floors but the polishing is required much less frequently.

Upstairs we use velvet carpets of double width and plain colors, sewed together to form a mat or rug, but without a border, and extending within 6″ or 8″ of the side walls all the way around. We find that no nailing strips or other means of fastening are necessary, since the carpet lies perfectly flat and is sufficiently large so that it will not move about.

Downstairs we use Oriental rugs entirely and a curious feature in this respect is that moths will not hatch on the under side of a rug in contact with concrete, where they do hatch when it is in contact with wood. This applies to the under side of the rug only, because it is not impossible for them to hatch within the rug fabric itself.

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[1] From Concrete, Correspondence Dept., Jan., 1915, p. 41

[2] Los Angeles, Cal.

Now, the common impression is that a concrete floor will make the room cold, but this impression is reached by people who have gone into rooms with concrete floors where there was no carpet on the floor and because at the moment, they were critical of concrete, but if one will go into a bare room where hard wood floors have been used they will get exactly the same effect. The addition of carpets and tapestries decreases the number of square feet where the air of the room comes in contact directly with the floor or side walls.

There is also an impression that concrete floors are damp. They are damp for the first 2 mos. after being laid and on this account should not be varnished or waxed, but after this period they are as dry as wooden floors. I have made accurate tests with hygrometers, to determine this point.

The concrete floor is to me most satisfactory because it is free from cracks in which dust accumulates and ascends every time the floor is flexed by stepping on it. There is never a squeak or other noise produced by the rubbing of one board of the interior floor on another. With carpet on the floors they are absolutely noiseless, and one cannot detect a person walking on an upper floor when he is in the room below, provided, of course, that there is a carpet on the floor above.

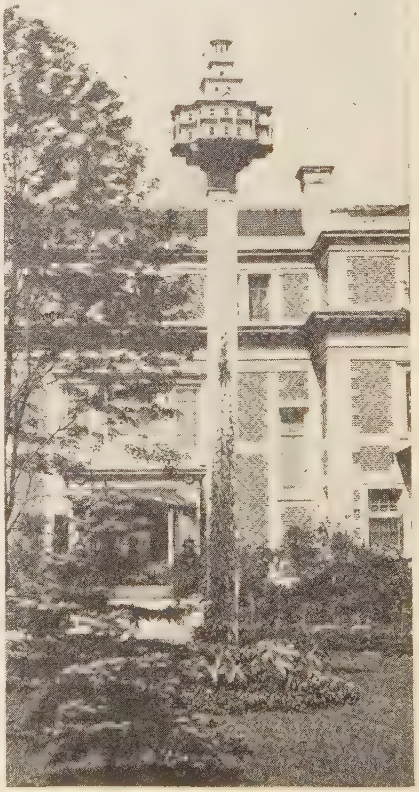
The concrete floor makes a much handsomer setting and background for Oriental rugs than wooden floors and one can do away with the unsightly baseboard, which always collects dust. Then there is none of the trouble of warping and straining which comes with the use of wooden floors.

Above all else the house is fireproof when properly built in other respects and one can leave home with the assurance that neither property of any considerable value nor lives will be destroyed in the event of fire. I feel that my pictures, rugs and porcelains are as safe in my house as in a vault at the bank, barring the possibility of theft, which is rather remote.

* * *

Supplementing what Mr. Laughlin says, his architect, Mr. Gill, in writing of concrete floors for residences in *Sunset Magazine*, says in part:[1]

> To overcome the popular prejudice against concrete floors is the business of the architect. There are certain definite conditions to be observed in laying concrete floors. They are fundamental and in their strict observance lies the answer to the charge of the physical discomfort of concrete. After practical objections are overcome, attention may be given to esthetic considerations.
>
> Concrete floors are usually laid free from the ground, with a dead air space underneath. In most of my houses the concrete floors are laid directly on the ground (in California), doing away with air circulation under the floor and giving a more equable temperature. They are raised at least 21″ above the surrounding ground, and particular attention is paid to the preparation of the earth bed. After the foundation is laid the ground is puddled and tamped until very firm. Over the surface is spread from 4″ to 6″ of sand or sandy loam. Then the concrete is put on. If one part of the floor is below grade, the ground under it is carefully drained, after which the layer of sand prevents moisture from coming through.
>
> The main body of rough concrete should be reinforced to 1/3 of 1% to prevent cracking, and scored to give a key to the top coat and prevent its loosening from the bottom. The finish coat should be reinforced with No. 18-ga. ½-in. mesh galvanized wire to prevent cracking.
>
> From 4 wks. to 6 wks. should be allowed for concrete floors to dry. During this time there is a continuous process of absorption and radiation of heat until a mean temperature has been reached, after which the temperature of the floor is more equable than that of wood.
>
> To cover a concrete floor with wood is about as logical as to cover concrete sidewalks with boards. Everybody who has lived on concrete floors laid according to the given specifications has been wholly converted to them and would never again be bothered with the care and trials of wood floors. It is not, of course, expected that concrete floors should be left bare. They should be partly covered with rugs, the same as a polished wood floor. Incidentally, when properly laid, waxed and polished, cement floors are ideal for dancing.
>
> When troweled and finished to a gloss, concrete floors do not mar or scratch. They should not be scored or marked off into squares or designs. The natural crazing of the top coat is far more pleasing. I have found no cement floor paint that produces a good effect. The hard, monotonous flat colors are unpleasing, the paint soon wears off and shows the cement. Instead of using paint, I mix color with the cement, usually tones of red and yellow, red and brown or yellow and brown slightly mottled. Tempered by the gray of the cement, these colors produce neutral tones that are a splendid background for rugs and furniture. When quite dry, the cement should be cleaned with a weak solution of ammonia and water, given two coats of Chinese nut oil to bring out the color, then finished with a filler and waxed like hardwood. Well done, this treatment gives an effect of old Spanish leather.
>
> It is quite as impossible to tell how to lay and finish a concrete floor to bring out all its potential beauty as it is to give exact rules for painting a picture. Specifications and instructions carry one just so far, but beyond that point each builder must study out the problem for himself. It takes the knack or the inspiration or the gift—whatever its name—that differentiates craftsmanship from mere mechanical perfection, that raises the artist above the artisan, to make a concrete floor the thing of beauty it can and should be.
>
> Before it has set, cement is a wonderfully plastic material, more wonderful than clay. It can be colored, modeled, shaded and surfaced, and then of itself hardens into an everlasting expression of the workman.
>
> The protest against ordinary concrete floors is the unconscious demand for the thing well done. At heart we are never satisfied with any work that is not done right, and concrete floors will not come into their own until architect and workman study them as an art.
>
> The cement floors in the home of Homer Laughlin, in Los Angeles, forecast the possibilities of the future. Sprawling there, his soul in his work, with great sweeps of his trowel an artist wrought in that plastic, responsive material, blending the colors marvelously in the broad central spaces, coaxing them to a rare harmony of tone and exquisite finish, and around the outer edges he carved in low relief the lines of acanthus and other simple conventionalized leaf forms. In the entrance hall, with big, free strokes he limned the feather-like fronds of a palm, using his color with consummate skill and an artist's feeling. The appeal of this most modern manifestation of ceramic art is far more subtle than that of the mosaics, which were the acme of floor-making among the Greeks and Romans, and it has the singular advantage of being within reach of beauty lovers of moderate means.
>
> Concrete floors are cheaper than wood for the first story; they are enduring, they require a minimum of care, they are comfortable and healthful when laid right, and they can be more beautiful than any other floor.



A Martin House on a Concrete Post

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[1] From Concrete, May 1916, p. 194

Bonding Plaster Coating to Interior Walls and Ceilings[1]

THE FOLLOWING QUESTION IS DISCUSSED BY:

C. W. J. NEVILLE[2]

EMMET A. STEECE[3]

W. M. KINNEY[4]

"How should concrete surfaces, left by wooden forms, be treated so as to secure a good key for interior plaster on walls and ceilings?"

BY MR. NEVILLE

Anyone who has carefully examined the under surface of a concrete slab after the forms have been removed and the concrete has thoroughly dried out, will probably have noticed a thin, loose coating of dried-out cement, ordinary dust and sometimes smoke, adhering to the slab. After having examined a number of cases of falling plaster, I have found in every case this film of dry dust between the plaster and the concrete, and have reached the conclusion that this and this alone is the cause of the failure.

Within the last 12 yrs., I have constructed concrete buildings, using both cinder and gravel concrete and have never had a single case of falling plaster. My instructions to the plaster foreman have invariably been as follows:

(1) See that the surface of the concrete is *absolutely clean*. This ordinarily may be accomplished by washing with a hose but sometimes it will be necessary to use a weak acid solution and a brush.

(2) See that the surface is well dampened just before the plaster is applied.

(3) Use only two coats of plaster, a scratch coat and a finishing coat, and make these as thin as possible, the thinner the better.

(4) See that plenty of "elbow grease" is used in applying the plaster and that it is thoroughly pressed against the concrete surfaces while being applied.

BY MR. STEECE

In the treatment of concrete surfaces in order to secure the adhesion of plaster or to provide a satisfactory plaster bond many methods have been used, experiments tried and failures met with. The proper method to use should not be resolved into a pride of opinion, for a failure means money thrown away.

I know of about six methods of concrete surface treatment, which will be described—not in the order of merit—as follows:

(1) Merely cleaning the surface of concrete as left by the forms with a stiff wire brush, washing with clean water and while still damp (not wet) applying the plaster.

(2) Washing the surface with a 25% solution of hydrochloric (muriatic) acid, then washing with clean water, and finally brushing with a wire brush.

(3) Cleaning the surface with wire brush, as in the first and the second method, then applying a liquid "plaster bond"—so-called—with an ordinary paint brush.

(4) Chipping or scoring the concrete with stone-cutter's tools.

(5) Lathing the concrete surface with metal lath. Eight-penny wire nails are driven into the form lining to a depth of about 1¼″ and 6″ apart each way. The nail points project from the surface when the forms are removed and the lath is simply laid on and the nail points clinched. In using this method it is sometimes desirable to provide a folded sheet metal washer or clip over the nail head to increase the holding power of the nail and to lessen the liability of pulling out when wrecking the forms, but if the head of the nail is above the plane of the reinforcing metal this is not always necessary. In this case the concrete needs no cleaning.

(6) Molded key, made by nailing long wood strips to the form linings. The strips to be ⅜″ thick by ¾″ wide, parallelogram-shaped section and spaced not over 6″ apart. The strips will draw out with linings when the forms are wrecked and a return beveled groove is made. This method gives satisfaction if properly executed and, with the exception of the usual cleaning, no other treatment is necessary.

From my personal experience and observation, I have arrived at the conclusion that the first method—if it can be so called—as described above will produce as good results as desired for plain plaster work, not exceeding ¾″ thick, particularly on ceilings. While I have known of tolerably heavy ornaments stuck on this class of ceiling work, ornamental work should receive special treatment. It must be borne in mind that the concrete surface must be clean and can be made so only by energetic use of the steel brush and water. If the forms—which will be referred to again—have been properly built, the finish coat of plaster can be applied directly to the concrete surface. In such a case, however, the finish coat should not exceed ¼″ thick, although there are many instances where this thickness has been exceeded.

I will digress at this point to refer to plaster before proceeding further: As to which kind of plaster produces the best results, certain conditions may have influence, but common plaster and hydrated lime or lime putty, if properly applied, will give good results for the finish coat. In all probability the best results are obtained, however, in finish coat work, by the use of a good Keene's cement and lime mixed in the proportion of 5 parts of the former to 3 parts of the latter. But these proportions have been departed from greatly and still good results have been obtained. Under some conditions it is desirable to add a small amount of plaster, but this can be left to the plasterer who has to do the work.

The great advantage in the use of Keene's cement in finish work comes from the fact that this material can be retempered even after 24 hrs. without material deterioration; of course, it should be kept from setting hard, but ordinary intelligence would require that to be done. This property obviates, to a certain extent, the danger of applying dead material to a concrete surface, with inevitable failure. In fact, many cases of plaster falling from concrete ceilings can be charged to dead material.

Some plasterers prefer hard or patent plasters to Keene's cement and if properly handled these will give satisfactory results.

Returning to the main subject: The method of treatment No. 2 listed above gives satisfaction but the acid should be entirely removed before applying the plaster.

Method No. 3, the liquid plaster bond — so-styled — might be used, provided the owner of the building or the contractor who is responsible for the integrity of the work, gets a bona fide guarantee of worth from the manufacturer of the material.

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[1] From CONCRETE, Information and Consultation Dept., Jan. 1915, p. 86

[2] Gen. Contr., New Orleans

[3] Supt of Cons., Federal Bldgs., Chickasha, Okla.

[4] Engr. in Chg., Inf. and Insp. Bur., Universal Portland Cement Co., Chicago

Method No. 4 is hardly to be recommended on account of the expense due to the amount of labor required to do a satisfactory job.

Method No. 5 is excellent, though expensive. Heavy ornaments can be attached to this class of work without fear of failure if properly executed.

Good results will be obtained by following Method No. 6, about which further comment is unnecessary.

While not a treatment, in the strict sense, it might be well to suggest that when the concrete surface remains wet, due to the hygrometric condition of the atmosphere, and rapid changes of temperature, it is advisable to use about 5% or more of plaster with the brown mortar. This suggestion applies particularly to lime and sand mixtures and to combination mixtures of mortar in which Portland cement is incorporated. The plaster (plaster of Paris) accelerates the setting.

No reference to "Treatment of Concrete Surfaces" would be complete without touching the subject of concrete forms, especially the linings. Form linings should be made of matched stuff, not to exceed 5½" wide, with the rough, or undressed, surface in contact with the concrete. The narrow width is for structural reasons and the rough surface is to mold the concrete rough, thus performing the function of scoring as applied to the scratch coat of plaster work. It should be needless to state that the forms should be absolutely straight, for an uneven surface makes trouble for the plasterer.

By way of further comment, it may be pointed out that if the plasterer has much interest in the integrity of his work, and I am pleased to say that most of them have, a properly prepared concrete surface needs no nostrums to assist plaster to adhere to it.

By Mr. Kinney

To cause plaster to adhere firmly to concrete surfaces as left by wooden forms, the concrete should be roughened and thoroughly wetted before the plaster is applied.

If in filling the forms the workmen do not take the trouble to spade the coarse aggregate away from the interior forms, the surface will usually be rough enough to form a good key without subsequent roughening of the concrete surface. In any case the concrete should be thoroughly wetted before plaster is applied.

If the interior surface is smooth as a result of spading, so that the fine material of the mortar has been brought against the forms, the concrete should be roughened by the use of a stone pick or a bush-hammer. The bush-hammer is usually preferable in case the forms have been oiled, as it tends to break up the entire surface.

Where the builder desires to eliminate "sweating" resulting from condensation as a result of difference between inside and outside temperatures, nailing strips or wall plugs may be inserted while placing concrete; to these furring strips of wood or metal may be attached to provide an air space and to receive metal lath or wire mesh to which the plaster is applied.

Application of Sulphate of Zinc to Concrete, Preparatory to Painting[1]

The Following Question is Discussed By:

William M. Kinney[2]

"What quantity (weight) of sulphate of zinc per gallon of water should be used to make a wash to be applied to concrete block already in the structure preparatory to receiving a coat of paint?"

By Mr. Kinney

Under the title, "Methods of Painting Cement Surfaces," Edward Hurts Brown, in the *Cement World* of June 15, 1909, says, in writing of the zinc sulphate process:

> The method recommended by Charles F. MacNichol, a prominent painter of Washington, D. C., who has used it extensively on government and private work with uniformly successful results, is economical and has no injurious after effects on either the concrete or the paint, and moreover requires no after washing. He coats the concrete with a solution of zinc sulphate and water, mixed equal parts by weight, applying it with a bristle brush and allowing from 48 hrs. to 72 hrs. to dry. This causes a chemical change in the caustic lime, changing it to calcium sulphate (gypsum), and when the surface has thoroughly dried there will be a certain amount of zinc oxide in the pores of the concrete or upon the surface. This material being one of the most important of the white paint pigments, naturally has no harmful effect upon any subsequent paint coats, but is incorporated with them by brushing.

Mr. MacNichol's process attracted so much attention that he was invited by the Am. Soc. for Test. Mat. to read a paper before that society, June 30, 1910. This paper, entitled "The Painting of Cement and Concrete Structures," is incorporated in the Proceedings of the 30th Annual Meeting of the Am. Soc. for Test. Mat. Mr. MacNichol therein says:

> The method consists in treating the concrete surfaces with a solution of zinc sulphate and water, equal parts by weight, applied with an ordinary bristle brush after the concrete is dry. If the one precaution is observed of allowing from 48 hrs. to 72 hrs. as a drying period, this treatment will render a concrete wall as safe to paint as an ordinary plaster wall.

Mr. MacNichol states that he is not a chemist but a master painter. Therefore, desiring to know the chemical action which made the application of zinc sulphate so effective, he wrote to Dr. Allerton S. Cushman, then Chemist in Charge of Physical and Chemical Investigations, Office of Public Roads, Washington, D. C., propounding the question: "What chemical action takes place on a concrete surface when a solution of zinc sulphate has been applied?" In reply to this question Dr. Cushman said:

> In regard to the scheme for painting concrete work with a solution of zinc sulphate in order to make the surface hold a paint coating, it is my belief that zinc sulphate is very well adapted for this purpose, owing to the fact that when zinc sulphate is brought into contact with calcium hydroxide (hydrated lime), a chemical reaction takes place which results in the formation of calcium sulphate (gypsum) and zinc hydroxide (hydrated oxide of zinc).
>
> It is apparent from this that after the surface has become thoroughly dry again it will contain within its pores a mixture of gypsum and zinc oxide; these materials have no bad influence on linseed oil and, in fact, are frequently used as paint pigments.
>
> The reason why some such treatment should be necessary before applying a paint coating to the surface of concrete must be apparent to everyone. When Portland cement sets, a certain amount of lime is set free in a hydrated condi-

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[1] From Concrete, Information and Consultation Dept., Jan., 1915, p. 37

[2] Engr. in Chg., Inf., and Insp. Bur., Universal Portland Cement Co., Chicago

tion as calcium hydroxide. This is a strong alkali, and tends to saponify the oil in the paint coating and thus destroy it. The work done by the application of zinc sulphate is to destroy this alkalinity, and change the calcium hydroxide into a mixture of calcium sulphate and zinc oxide.

Engineering & Contracting for Mar. 20, 1912, contains an article by Jerome Cochran, entitled "Inspection of Surface Finishes for Concrete Work." Under the heading, "Painted Surfaces," Mr. Cochran says:

> Concrete surfaces may be treated with a solution of zinc sulphate and water, mixed equal parts by weight, and applied with an ordinary bristle brush after the concrete is dry. The concrete should be at least 48 hrs. old, preferably 72 hrs., before applying the zinc sulphate solution.

CONCRETE-CEMENT AGE for May, 1913, publishes on page 241 the following letter from Andre L. Casset, 15 Avenue d'Allemagne, Paris, France:

> I believe that your readers would be glad to know a simple and effective process of painting over concrete surfaces. The reason that oil paint does not stand well on concrete surfaces is that the oil is saponified by the free lime of the cement. We have found it good practice to put on a coat of cheap metallic sulphate solution, say zinc sulphate, about a 1:5 solution. This produces, by the following reaction, a coat of plaster and zinc sulphate quite harmless to oil over the concrete surface. ($CaO+SO_4Zn=CaSO_4+ZnO$).

The *National Builder* for Aug., 1914, contains an article by R. H. Langston, from the *Master Painter*, entitled, "Painting over Cement." This article says:

> It must be understood that ordinary linseed oil paint cannot be applied with success directly to cement or concrete surfaces, on account of the alkaline lime present in the cement, which is subject to prolonged formation in the presence of moisture. The action of this alkali is to burn up or destroy the oil, causing rapid fading of colored paint, chalking and scaling off of the material. Therefore it is necessary, if a linseed oil paint is to be used, that the surface be first thoroughly saturated with a neutralizing wash that will destroy the alkali action. The most approved method is to use a solution of zinc sulphate made by dissolving sulphate of zinc crystals in water in the proportion of 3 lbs. per gal. of water. A cement surface treated with this wash and allowed to dry can then be painted without danger from alkaline action and with the assurance that the result will be as lasting as if applied to a wood surface. Many manufacturers now put out cement paints in liquid form, ready for use, in white and all shades, the vehicle used in these paints being alkali-proof and therefore requiring no treatment of the surface before the paint is applied. Paints of this nature are being used extensively on cement and concrete construction with the very best results and can be obtained at a very reasonable price.

In the *Architect and Engineer*, for Oct., 1914, there is an extract from a paper on paint protection for Portland cement surfaces, by H. A. Gardner, Washington, D. C., which was read recently before the Am. Soc. for Test. Mat. In this article Mr. Gardner says that a priming coat of 25% zinc sulphate solution was applied to concrete to neutralize any free lime, but it is held that this is unnecessary if the surface is dry when painted and is not to be exposed to the weather. Tests conducted showed that the amount of free lime in thoroughly dry cement surfaces does not adversely affect high-grade oil paints. They also showed that zinc sulphate may be used with excellent results as a primer to neutralize free lime in cement surfaces which are to be painted. Reference to this article will show the classes of paints which were tested in reaching the determinations recounted in Mr. Gardner's paper.

The various authorities upon the quantity of sulphate of zinc are therefore found to be as follows:

(1) Charles MacNichol: "A solution of zinc sulphate and water, equal parts by weight."

(2) Jerome Cochran: "A solution of zinc sulphate and water, mixed equal parts by weight."

(3) Andre L. Casset: "Zinc sulphate in about a 1:5 solution."

(4) R. H. Langston: "A solution f zinc sulphate made by dissolving sulphate of zinc crystals in water in the proportion of 3 lbs. per gal. of water."

(5) H. A. Gardner: "Twenty-five % zinc sulphate solution."

Stucco on Metal Lath—How to Secure Good Work[1]

In reply to inquiries on the probable life of stucco on metal lath and proper methods of application, CONCRETE *published (Oct., 1915, p. 151) a symposium on the subject in the form of extracts from letters from numerous contractors and engineers. Space is not available for reproducing the entire matter, but the following conclusions were reached from the discussions submitted:*

1. The structure on which the metal is secured must be exceptionally rigid and well braced. Framing should be so placed as to allow a minimum of shrinkage. Narrow sheathing is preferable and best results are obtained where it is placed diagonally on the studs.

2. Galvanized lath is best, but necessarily more expensive. Improved paints are being worked out that may be satisfactory. Unpainted lath is not generally satisfactory, owing to its likelihood to become badly rusted before it can be covered with mortar.

3. Given a rigid, well braced frame, best results are obtained by back-plastering. If sheathing is used it should be covered with waterproof paper. Furring (preferably metal) should be narrow and should allow the entire space between the lath and the sheathing to be filled with mortar so as to embed the metal completely.

4. Corners must be left free to give with temperature movements.

5. Stucco must be carefully proportioned, placed and protected according to standard specifications as given by the American Concrete Institute, the Portland Cement Assn., the Nat. Lime Mfrs. Assn. or the Associated Metal Lath Mfrs. (Copies may be obtained free by addressing these organizations.)

6. Special conditions have much to do with the life of stucco, such as exposure near salt water and to fumes from certain industries.

SPECIFICATIONS

The Am. Concrete Institute has for a number of years given much attention to perfecting stucco. Following is a summary of its specifications:

PREPARATION OF ORIGINAL SURFACE

The frame is to be rigidly constructed. Sheathing to be from 6″ to 8″ wide, laid diagonally and nailed with two nails at each stud. Sheathing to be covered with waterproof paper laid horizontally, paper to lap well at all joints.

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[1] From Information and Consultation Dept., CONCRETE, p. 151, Oct., 1915. Space is not available for other discussions published at this time

Furring to be of metal crimped strips not less than ¼″ high, No. 18 ga. galvanized or equal. Strips to be not more than 16″ o. c. and over studs. Closer spacing to be used on curved surfaces so as to hold the lath ¼″ from the sheathing. Furring strips to be placed not less than 1½″ nor more than 4″ from all openings and provided at all vertical joints of the lath.

METAL LATH

Metal lath shall be woven wire, expanded or deformed sheet metal. It shall be galvanized and no cutting or punching shall be done after galvanizing except that necessary for erection.

The metal shall be of such shape that when in place plaster applied and forced through against the sheathing boards will completely embed the metal.

Lath shall be placed with its stiffest axis horizontal and fastened by galvanized staples not more than 8″ apart, which shall straddle the furring strips and reach to the inside of the sheathing. Each sheet shall lap the next one mesh or one row of deformations.

[*Editor's Note:* In order to make this summary complete, specifications for wood lath and masonry are included.]

WOOD LATH

Over sheathing paper shall be placed vertically 8″ o. c., No. 1 spruce, cedar or white pine laths, well nailed. There shall be applied over these horizontally the same quality laths, spaced ½″ apart, nailed with galvanized nails at each furring strip.

The lath shall be thoroughly wet with a hose, using sufficient force to drive the water back of the lath, and time shall elapse before applying the mortar sufficient for the lath to absorb the water.

Immediately after placing the first coat of mortar the surface shall be scratched and 1-in. mesh chicken wire stapled over the mortar with galvanized staples. The wire shall be lapped 1′ at corners.

BRICK TILE AND CONCRETE

Old surfaces shall be thoroughly cleaned and joints raked out ½″. If the surface has been painted or cannot be cleaned, metal furring and lath shall be applied.

New surfaces shall have ample roughness to assure a good bond. Mortar joints shall be ⅜″ thick and raked ½″ deep. All surfaces shall be thoroughly saturated before applying stucco.

MATERIALS

Cement shall meet standard specifications. Fine aggregate shall be graded from fine to coarse and pass when dry a screen having ¼-in. holes. It shall be clean and free from dust.

Hydrated lime is to be preferred, but when lump lime is used it shall be slaked in 2½ volumes of water and shall stand 1 wk. before using.

When quick lime slaked on the job is used, 35 lbs. of lump lime shall be allowed to 1 bbl. of cement. Hair or fiber shall be first quality cow hair or long cocoanut fiber, well combed.

Coloring matter, if used, shall be a mineral which is not affected by lime or cement. The water used must be clean and free from oil and alkali.

MIXING

The ingredients shall be thoroughly mixed dry until of even color. Slaked lime shall be mixed with water to the consistency of thin cream and added to the mix in that form. Dry hydrated lime is to be added to the batch before dry mixing.

All materials shall be accurately measured, all proportions are stated by volume. No more mortar shall be mixed than can be used within 1 hr. and no mortar is to be retempered.

Mixing by hand is to be done on a tight platform and materials turned until homogeneous. The mortar shall contain sufficient water to insure a proper bonding and a dense mortar free from voids.

SCRATCH COAT

The first coat shall be mixed 1 cement, 2½ aggregate and ¼ part dry hydrated lime. Sufficient hair is added to bind the mortar when applied to lath; 3 lbs. to 4 lbs. hair per bbl. of cement is about right. The scratch coat shall be pushed through the lath so as completely to fill the space between it and the sheathing and all voids around furring and laps.

When applied to masonry mortar shall be forced into all voids of the saturated surface. The minimum thickness of the scratch coat over the lath shall be ¼″.

Precautions must be taken to prevent rapid drying in hot weather and the surface shall be thoroughly scratched and roughened.

INTERMEDIATE COAT

The intermediate coat shall consist of 1 part Portland cement, 3 parts aggregate and ¼ part hydrated lime. This coat is applied as stiff as it can be worked to secure greater impermeability; it shall be applied over a thoroughly wet scratch coat as soon as the scratch coat is hard enough to work upon. The thickness shall not be greater than ⅜″ and it shall be well troweled into contact with the previous coat. This coat shall be properly scratched and protected. The intermediate coat may be omitted over masonry.

FINISH COAT

The finish coat shall be mixed with the same proportions as the intermediate coat. Colors when used are to be thoroughly mixed with the dry material. It is desirable to mix enough material dry for the entire job at once to secure uniform color.

The finish coat shall be applied to the wetted under coat as soon as practicable. It shall be not more than ¼″ thick over the intermediate coat nor more than ⅜″ thick over a scratch coat. It shall be pressed on hard but troweled no more than is necessary to secure an even surface.

SURFACE FINISH

Smooth Troweled—The finishing coat shall be troweled smooth with a metal trowel with as little rubbing as possible.

Stippled—The finishing coat shall be troweled smooth with a metal trowel with as little rubbing as possible and then shall be lightly patted with a brush of broom straw to give an even stippled surface.

Sand Floated—The finishing coat after being brought to a smooth, even surface shall be rubbed with a circular motion of a wood float, with the addition of a little sand to slightly roughen the surface. This floating shall be done when the mortar has partially set.

Sand Sprayed—After the finishing coat has been brought to an even surface it shall be sprayed by means of a wide, long fibre brush—a whiskbroom does very well—dipped into a creamy mixture of equal parts of cement and sand, mixed fresh every 30 min. and kept well stirred in the bucket by means of the whiskbroom or a paddle. This coating shall be thrown forcibly against the surface to be finished. This treatment shall be applied while the finishing coat is still moist and before it has attained its final set, i. e., within 3 hrs. to 5 hrs. To obtain lighter shades add hydrated lime of 5% to 15% of the volume of the cement.

Splatter-Dash or Rough-Cast—After the finishing coat has been brought to a smooth, even surface and before attaining final set, it shall be uniformly coated with a mixture of 1 part cement and 2 parts of sand thrown forcibly against it to produce a rough surface of uniform texture when viewed from a distance of 20′. Special care shall be taken to prevent the rapid drying out of this finish.

Pebble Dash—After the finishing coat has been brought to a smooth, even surface and before attaining initial set, clean, round pebbles or other material as selected, not smaller than ¼″, or larger than ¾″, shall be thrown forcibly against the mortar so as to embed themselves in the fresh mortar. They shall be distributed uniformly over the surface of the final coat and may be pushed back into the mortar with a clean wood trowel, but no rubbing of the surface shall be done after the pebbles are embedded.

Exposed Aggregates — The finishing coat shall be composed of an approved selected coarse sand, marble dust, granite dust, or other special material, in the proportions given for finishing coats and within 24 hrs. after being applied and troweled to an even surface, shall be scrubbed with a solution of 1 part hydro-chloric acid in 4 parts of water by volume. After the aggregate particles have been uniformly exposed by scrubbing, the wall shall be thoroughly washed down by spraying with a hose to remove all traces of the acid.

Mortar Colors—When it is required that any of the above finishes shall be made with colored mortar, not more than 6% of the weight of Portland cement shall be added to the mortar in the form of finely ground coloring matter.

A predetermined weight of color shall be added dry to each batch of dry fine aggregate before the cement is added. The color and fine aggregate shall be mixed together and the cement and lime mixed in. The whole shall then be thoroughly mixed dry by shoveling from one pile to another through a ¼-in. mesh wire screen until the entire batch is of uniform color. Water shall then be added to bring the mortar to a proper plastering consistency.

WATERPROOFING

When a special waterproofing compound is to be added to mortar for stucco work, it shall be added to all coats in strict accordance with the specifications of the manufacturer.

CURING

Whatever finish is given the final coat, it shall be so protected from rapid drying out that the mortar shall have at least 4 das. to cure before drying on the surface. The walls shall be frequently sprayed by means of a hose and in dry weather shall be protected by burlap or other suitable hangings which may be kept wet.

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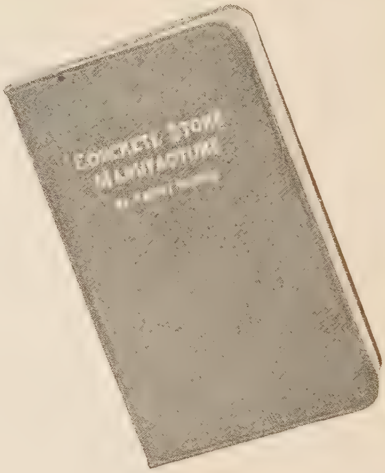

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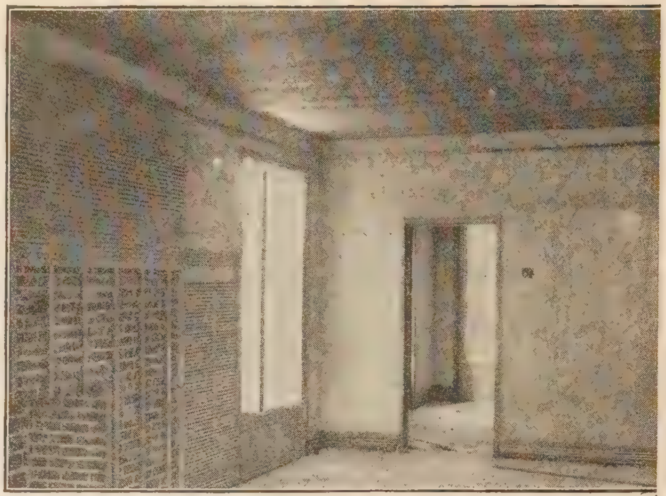

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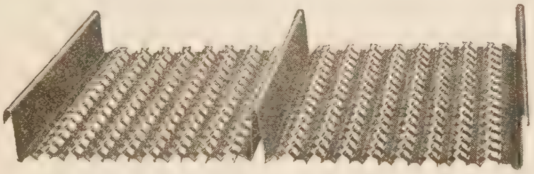

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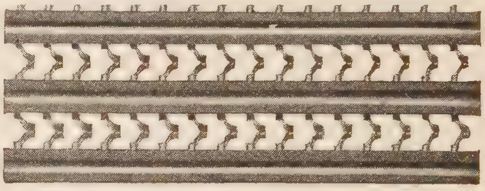

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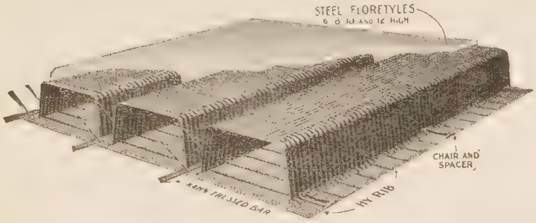

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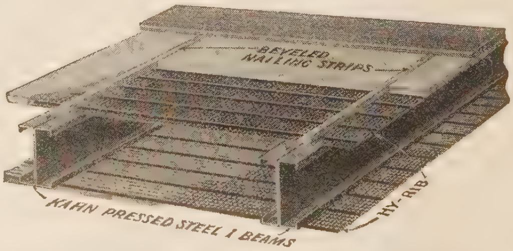

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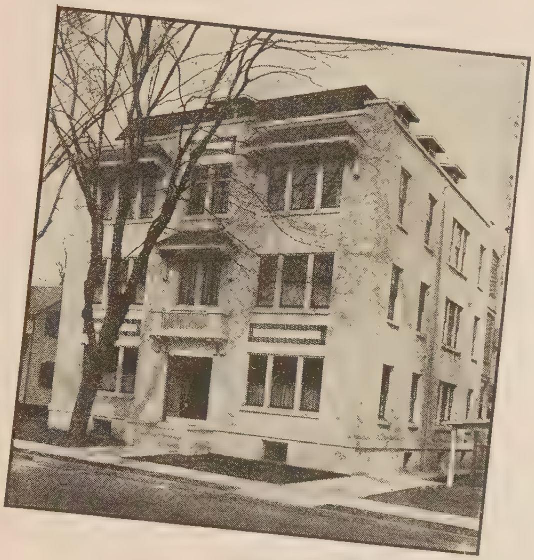

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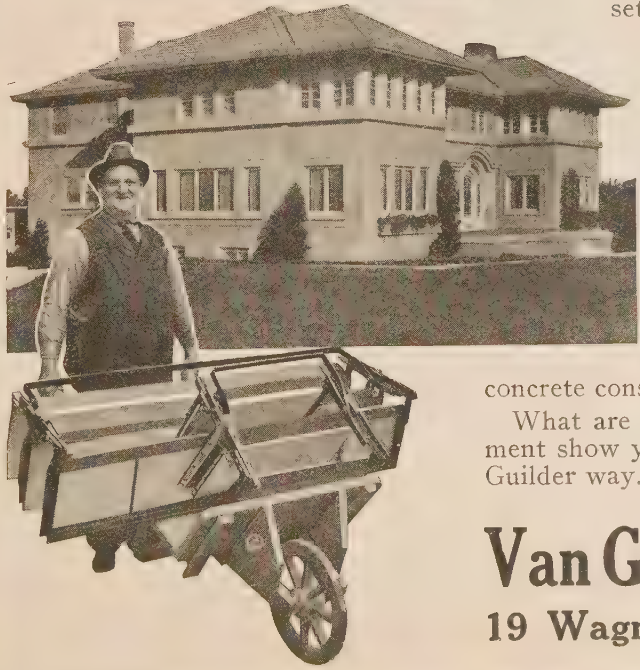

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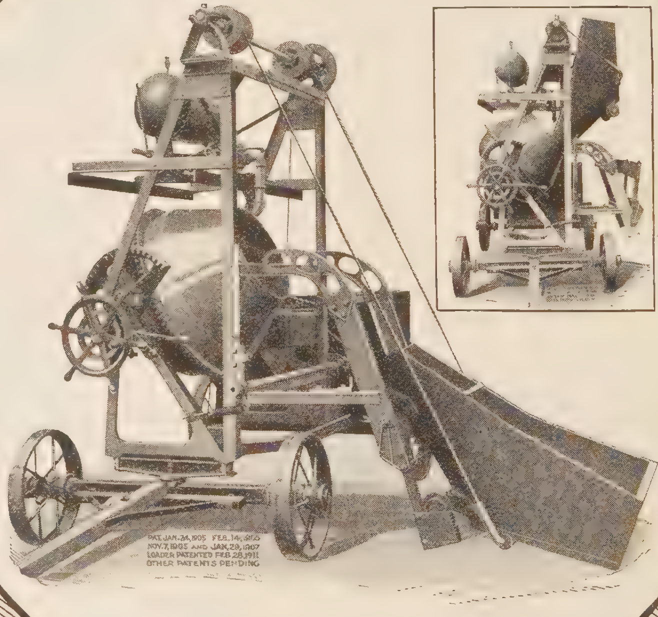
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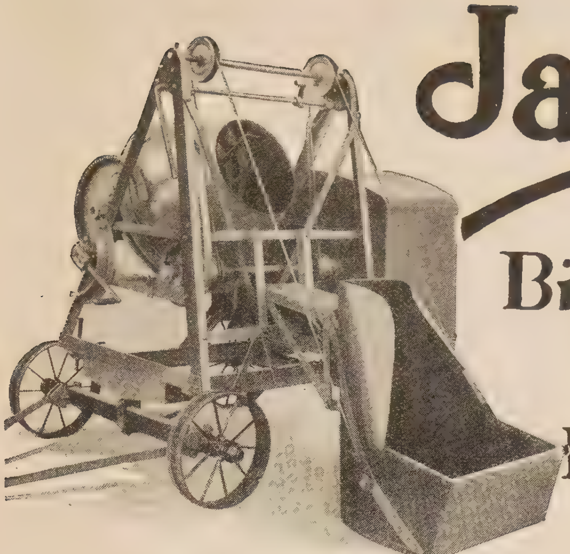

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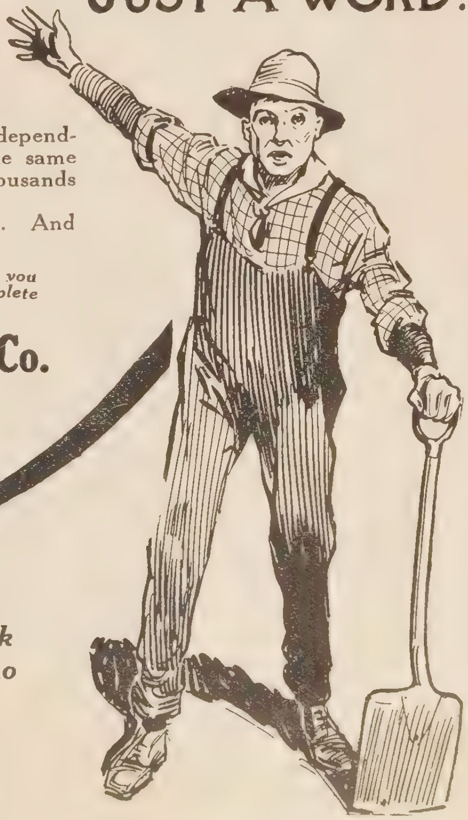

"Always Ask the Man Who Runs One--He Knows"

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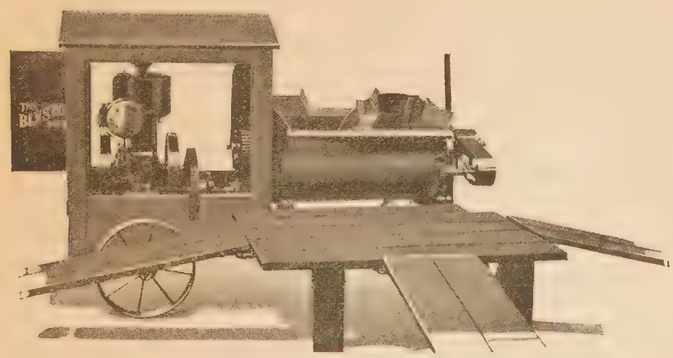

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Only Perfect Mix The Blystone Reverse Spiral Shovel System plunges six steel shovels down into the mass. They stir, shovel and trowel it from one end of the drum to the other 40 times a minute. The only perfect concrete mix.

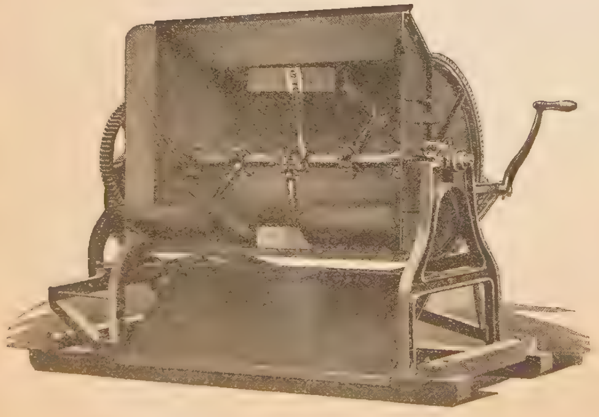
Simplicity The simplest mixer made. When you use a Blystone you will be surprised how many mixer parts you've been used to that are really unnecessary.

Durability The *only* wearing parts in a Blystone are the six shovel blades. These are adjustable to take up wear and can be renewed every few years if necessary—at little cost. A user said: "It seems this mixer can't be worn out."

No Wasted Power When you throw on the clutch of the Blystone automatic discharge, power equal to perhaps half an average man's strength dumps the mixer. The rest of your power is applied to the shovel shaft—that is, to the mixing.

Four Purpose Mixer No other mixer will do so many things efficiently. Concrete (outdoor contracting and products plants)—plaster, mortar and dry mixing. Everything that needs to be mixed on a job a Blystone will mix.

Let us send you our catalog showing the complete Blystone line. Write today.



Blystone on Skids for Products Plants

Blystone Manufacturing Co.

Venango Ave. Cambridge Springs, Pa.

Blystone is Made in Four Sizes—3, 5, 7 and 9 Cu. Ft. Capacity

k is due on last date given below.

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